Vol. XVII, No. 4 NOVEMBER, 1946

THE TOOL ENGINEER

OFFICIAL PUBLICATION OF THE ASTE AMERICAN SOCIETY OF TOOL ENGINEERS

Mechanization Increases Employment . . . . . *by A. M. Sargent*

Plant Layout and Materials Handling—A Symposium

Fitting Factory Layout to the Product . . . . . *by Andrew W. Kramer, Jr.*

Plant Layout and Materials Handling Studies . . . . . *by Haylett B. Shaw*

The New Involute Spline Standard . . . . . *by The Broaching Institute*

Planned Simplified Inspection . . . . . *by Philip G. Fishback*

Metal Surfacing by Hard Chromium Plating . . . . . *by Edwin H. Halvorsen*

Milling Attachments and Accessories . . . . . *by John E. Hyler*

"Blow-Up" Photos Facilitate Research and Inspection . . *by M. W. Seavey*

Departments

A.S.T.E. News • Andygrams • Gadgets • Fundamentals of Tool Engineering • Good Reading • Bulletins • Tools of Today • North, East, West, South in Industry • Index to Advertisers

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AMERICAN SOCIETY OF TOOL ENGINEERS

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American Society of Tool Engineers

National Headquarters

Phone: CHerry 8082
1666 Penobscot Bldg. Detroit 26, Michigan

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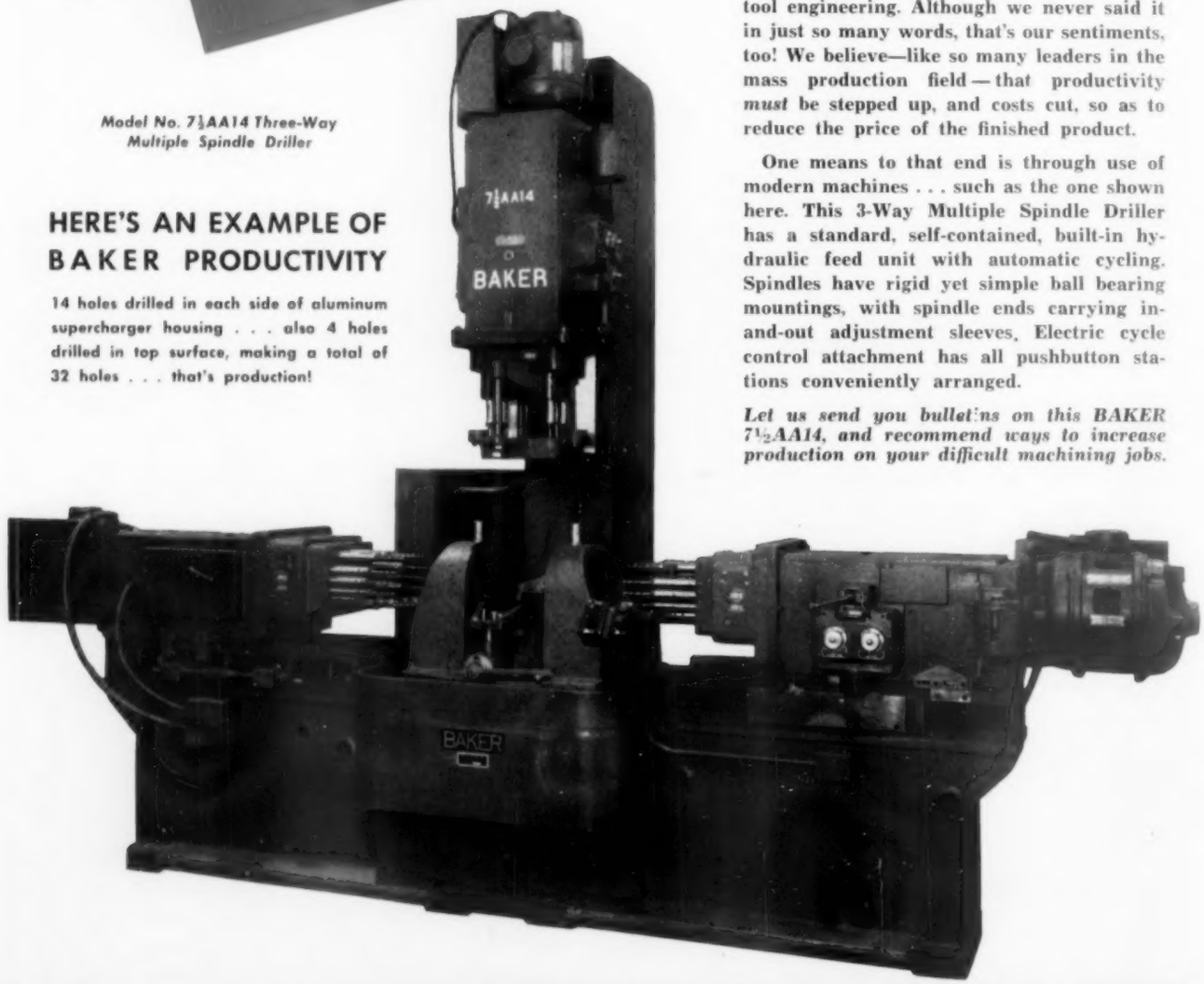

Model No. 7½AA14 Three-Way Multiple Spindle Driller

HERE'S AN EXAMPLE OF BAKER PRODUCTIVITY

14 holes drilled in each side of aluminum supercharger housing . . . also 4 holes drilled in top surface, making a total of 32 holes . . . that's production!

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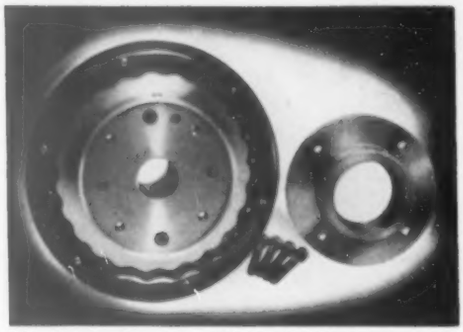
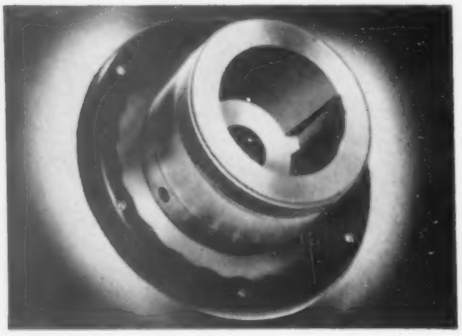
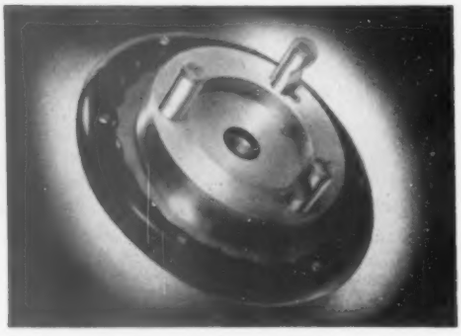


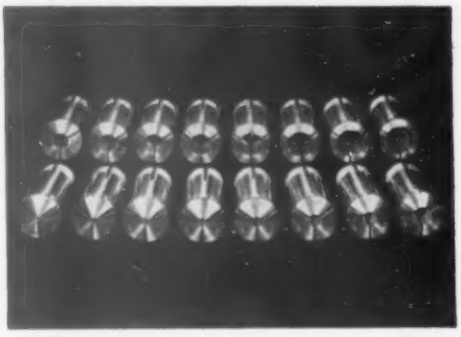
Hardinge-Sjogren Plain Back Chuck with Adapter plate for Machines with Threaded Spindle Nose.



Hardinge-Sjogren Chuck for Lathes with Tapered Key-Drive Spindle Nose.



Hardinge-Sjogren Chuck to fit directly on Lathes with Cam-Lock Spindle Nose.



Hardinge Precision Collets are available in a wide range of sizes; carried in stock in Elmira and other industrial centers.

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The Morse Spiral Fluted Tap is *free cutting* and, as it works into the metal, it automatically clears the chips from the hole, thereby eliminating clogged grooves.

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Differing from all other metal-cutting processes *Contour Sawing* is the only economical process for countless production jobs. It cuts parts, even intricate shapes with internal and external contours, in minutes—not hours or days.

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You'll be amazed how *Contour Sawing* "cuts down time". Write for illustrated booklet "DoALL Equals Ten Plus", which compares time savings of *Contour Sawing* with other processes.

The DoALL *Company*

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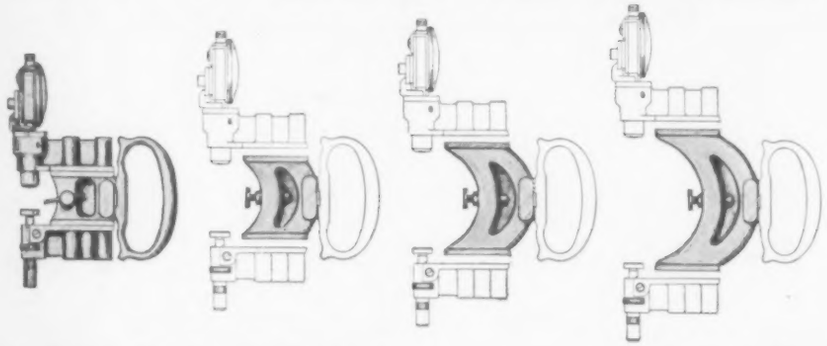
DoALL STORES IN PRINCIPAL CITIES

MACHINE-TOOL DIVISION
MINNEAPOLIS 4, MINN.

FOUR GAGES IN ONE

ONE PAIR OF HEADS AND FOUR EXTENSION SPACERS COVER 4" RANGE



SET, consisting of a pair of heads and four interchangeable extension spacers, effects marked saving in cost. Sets available for either 0 to 4" or 4" to 8" range.

Full Size Decimatic Indicator — **Tungsten Carbide Gaging Surfaces**

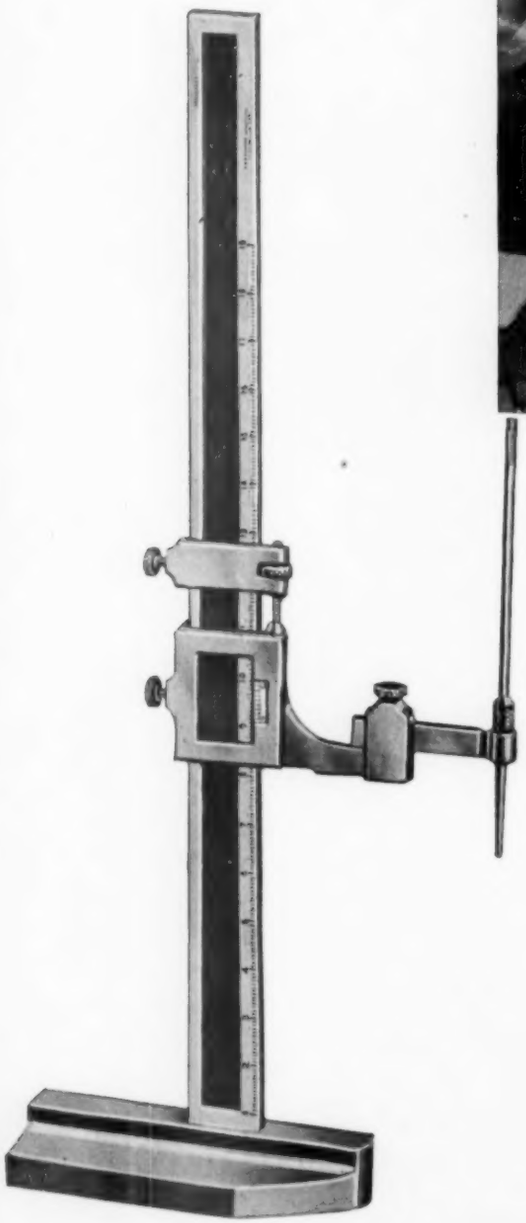
Easily Set to Blocks or Master — **Highly Consistent Repeatability**

Graduated in "Tenths"—Accurate to "Split-Tenths"

STANDARD GAGE CO., INC., Poughkeepsie, N.Y.

STARRETT TOOLS

TO COMPLETE THIS PICTURE



ADD THE RIGHT STARRETT TOOL

Add a Starrett Vernier Height Gage to the photo above and you have a picture that is familiar wherever fine precision work is done. Starrett Tools inspire the confidence of those who use them—help them make the most of their skill and experience. That's why it pays to insist upon *Starrett Tools* for all important measuring and inspection jobs. Be sure to specify *Starrett* when you requisition precision measuring tools.

Buy Through Your Distributor

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World's Greatest Toolmakers

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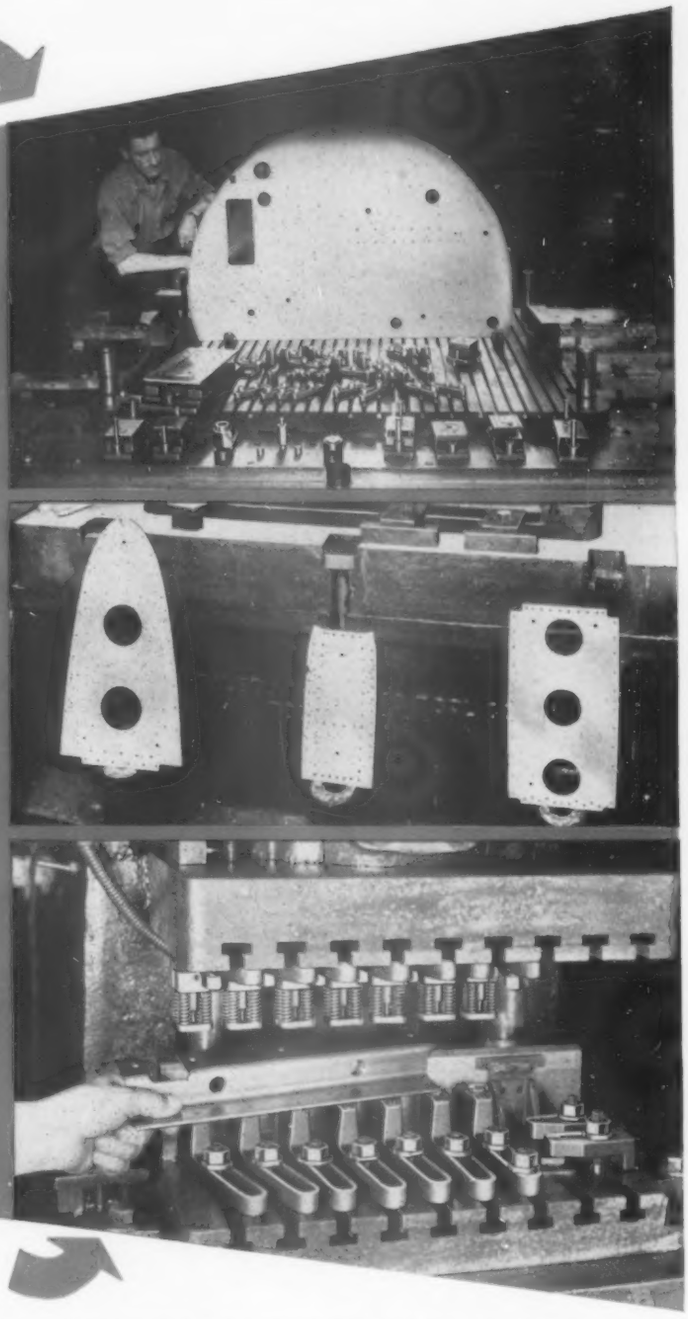
STARRETT

PRECISION TOOLS • DIAL INDICATORS • STEEL TAPES • GROUND FLAT STOCK

Some examples of what can be done with Whistler Adjustable Dies. Work in practically any type press.



Re-use same WHISTLER ADJUSTABLE DIES in unlimited combinations

1 To Pierce Holes of any diameter from 1/32″ up.

2 To Perforate Special Shapes.

3 To Notch Corners.

Save production time and reduce product costs by having Whistler punch and die units in your tool room.

Whistler notching dies, group dies and standard units are especially adaptable to combined use in the same set-up. Continued re-use in a variety of arrangements quickly writes off original investment. Reason enough for their expanding popularity with hundreds of America's best known manufacturers.

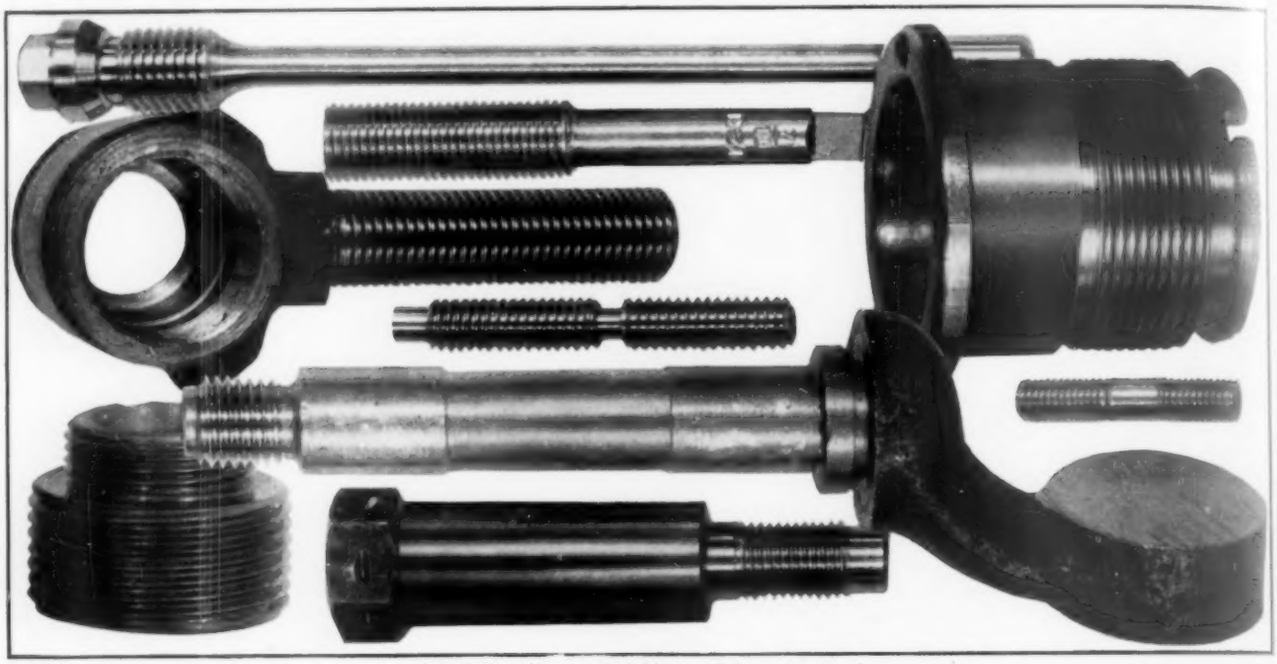
Now available from stock in a range of diameters up to 3″, shipment can be made the same day your order is received. Special sizes, shapes, notching and group dies are made to order in a few days.

You get production economy plus precision perforating in practically any press with these Whistler dies. Set-ups are easy and fast. No special tools required. Heavy duty series easily pierces 1/4″ steel. All parts interchangeable. Tolerances maintained to .0002″. There are many other advantages. Get in touch with Whistler.

WRITE FOR YOUR WHISTLER CATALOGS. Know the production advantages of Whistler Adjustable Dies.

S. B. WHISTLER & SONS, INC.
752-756 MILITARY ROAD BUFFALO 17, NEW YORK

PRECISION ROLLED . . . HIGH PRODUCTION



Actual Size, Unretouched Photos of Parts Produced

- ON -

Steinle Centerless

THREAD GENERATORS

The *Steinle* method will precision roll YOUR parts—HOLLOW, SOLID, or IRREGULARLY SHAPED—to CLASS 4 and 5 LIMITS—at productions up to 2400 pieces per hour — on THREAD ROLLING, SPECIAL FORMING, SERRATING, KNURLING, and BURNISHING.

The *Steinle* method will give you WIDE RANGE OF SIZES on ALL METALS—from pre-heat-treated high tensile alloy steels, stainless and monel, to brass and aluminum—No. 8 screw to 2¼"—HIGHLY BURNISHED. You can use UNSKILLED HELP.

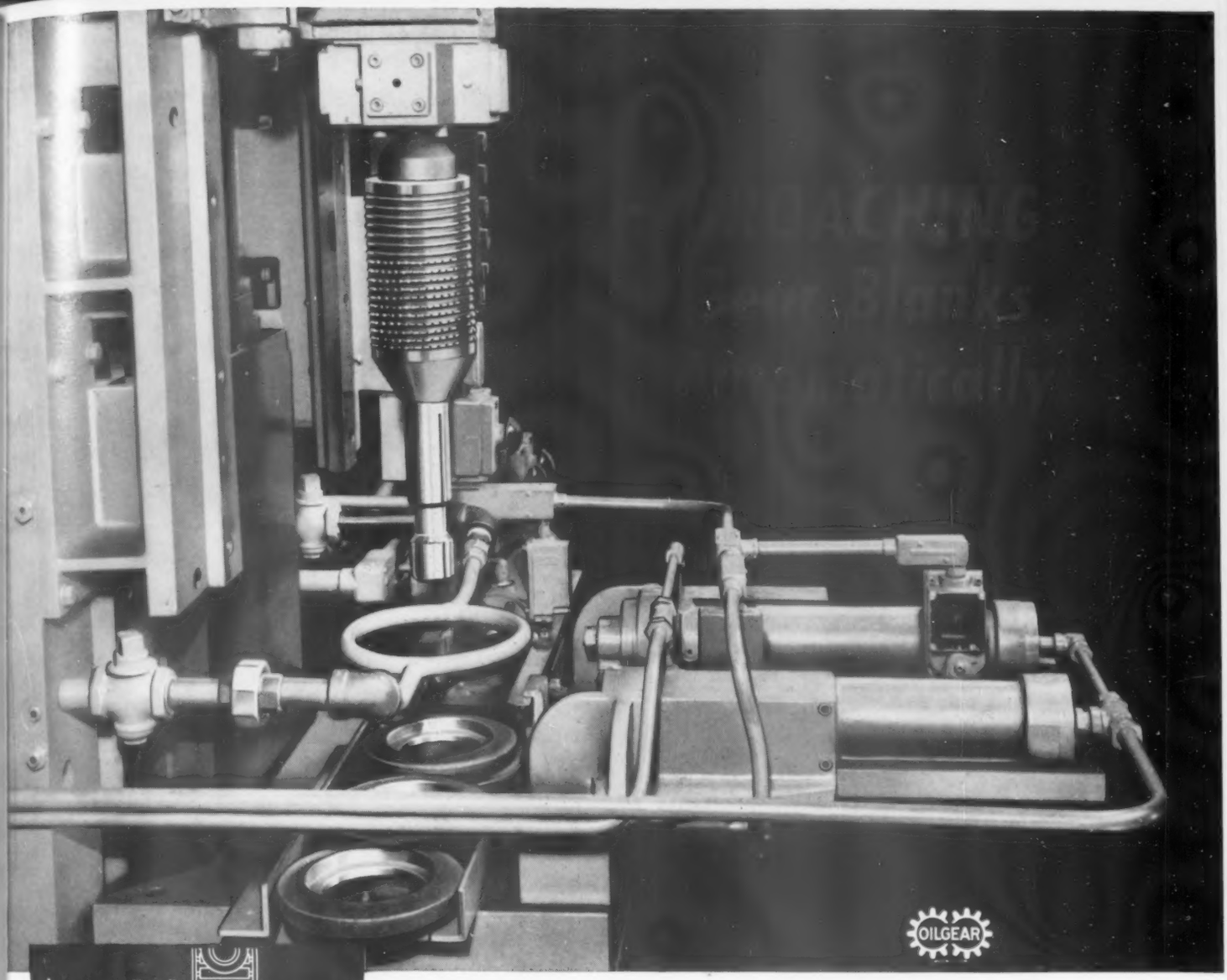
Job-to-Job change-over is FAST.

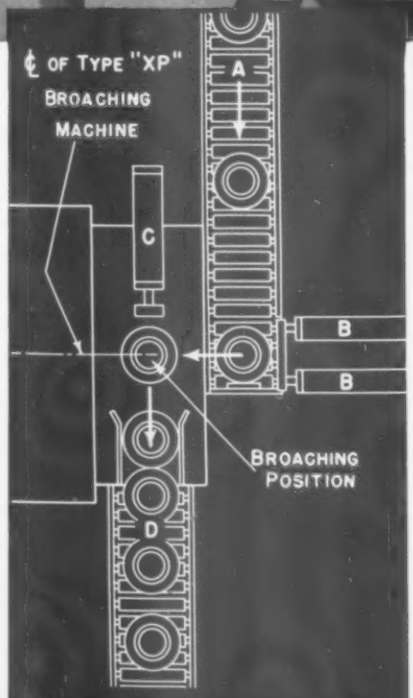
SMALL DIAMETERS
LARGE DIAMETERS
JUST CHANGE THE ROLLS

Demonstration at your Convenience

THE *Steinle* MACHINE COMPANY

HARTFORD, CONNECTICUT





Oilgear Vertical Pull-Down Broaching Machine continuously loads, broaches and unloads hypoid bevel gear blanks . . . *automatically.*

This Oilgear Type "XP" Vertical Pull-Down Broaching Machine with automatic loading and unloading mechanism is operating at the Fort Wayne plant of the Spicer Mfg. Co. Its job is to finish broach holes in the forged steel hypoid bevel drive gear blanks fed to it from a boring machine by means of a conveyor.

Two fluid power cylinders remove the blank from the conveyor and place it in the broaching position on the machine. As tool descends, shank accurately locates blank. Tool is pulled downward to broach part. Another fluid power cylinder pushes the finished part onto a second conveyor which takes it away. There's no manual loading—no levers or buttons to operate—no manual threading of part over tool shank—no cautious centralizing of part by hand—no manual handling of tool—no manual unloading. All operations are automatic, continuous and unattended.

The Oilgear Automatic Broaching Machine removes approximately .020" of stock on the diameter and produces 225 finished ring gear blanks per hour. Other sizes of bevel gear blanks can be broached on the same machine by changing the broaching shells on the tool steel bar.

If you are looking for faster production and lower costs, investigate Oilgear Broaching Machines, either vertical or horizontal for every type of internal and external broaching. They provide high broaching and return speeds, infinitely adjustable. They make more efficient use of electric power hence require smaller motors. They make more efficient use of oil medium hence require much smaller reservoirs. They provide manual, semi-automatic and full automatic control at no extra cost. THE OILGEAR COMPANY, 1308 W. Bruce St., Milwaukee 4, Wis.

Oilgear Fluid Power

CUT COSTS—SPEED PRODUCTION WITH *SUPER* EJECTOR-TYPE TOOLS*

MACHINES **ANY** METAL

SOLID CARBIDE REPLACEABLE BITS

- OUTSTANDING DESIGN FEATURES
- ECONOMICAL • FAST • VERSATILE
- EASY GRIND • SUPERIOR CUTTING PERFORMANCE

You cut costs . . . you increase efficiency when you use Super Ejector-Type Tools for Carbide-machining applications. Tests prove heat concentration is reduced—thermal checking almost totally eliminated. This means extra long life and higher production after sharpening . . . frequently permits using harder-than-ordinary grades of Carbide, with correspondingly higher cutting efficiency.

For better chip flow—smoother cuts, the bit-holding mechanism is inside . . . where it can't interfere with chips or assembly of tool in tool block. Well-supported replaceable Carbide bits are extra long and extra sturdy and take deep cuts with safety. Since the bit is mechanically held, there are no destructive brazing strains to weaken the tip.

Tool cost is sharply reduced! Compound-angles of the ejector mechanism permit feather-light regrinding cuts on top, end, and side and produce sharp, new cutting edge with minimum loss of Carbide. This versatile tool machines *any* machineable material. Replaceable Carbide bits are furnished in proper grade for each job. See your dealer or write for further information.

*PATENTS PENDING

See this tool demonstrated at space No. A-129, National Metal Exposition, Atlantic City, New Jersey, November 18 to 22.

SUPER TOOL COMPANY

Carbide Tipped Tools

21650 Hoover Rd., Detroit 13, Mich. 4105 San Fernando Rd., Glendale 4, Cal.

Mechanization Increases Employment

IT ALL STARTED some ten thousand years ago.

During the Bronze Age "somewhere in Asia" an unknown benefactor of humankind invented the wheel. From that time onward civilization has progressed rapidly . . . as time goes. The wheel has since become the basis of nearly every modern device used to decrease the physical effort involved in making products, to increase the efficiency and speed of manufacturing and, finally, to reduce the price of all commodities to the ultimate consumer.

Perhaps there were those, in the Bronze Age, who cried loudly that this epoch-making invention would create unemployment, bring on depressions, and, in the end, reduce the bulk of the human race to serfdom.

If such short-sighted "philosophers" existed in the dark ages, historians did not bother to record their frustrated wailings.

In modern times, however, there have always been a few misinformed individuals who have maintained that machines decrease employment and inflict a host of other miseries on the human race. Actually, if these "prophets" would spend more time in studying mankind's achievements and less of it in bleating to the world their ill-advised philosophies, they would find that the exact opposite of this is true.

The Census Bureau estimates that, about a hundred years ago, the average weekly wage of American workers was under $5, while the investment in machinery for their use averaged less than $500 per employee.

Machines have been responsible for a different picture today. With plant investments averaging over $7000 per worker, all Americans have increased their income greater than tenfold. On the other hand, automobile tires which cost wage earners $50 or more a quarter of a century ago can now be bought for less than half that amount—and tire life has been increased tenfold! Electric light bulbs that cost 60 cents a few years ago can now be bought, greatly improved, for ten cents.

More people are employed because the products they make are cheaper, thus enabling more people to consume the fruits of their work. It is an endless chain. Even with better and better quality merchandise each year, the trend of prices has always been downward, while wages and employment have always gone up. Combined, these elements have set the record high standard of living in America.

Tool Engineering, coupled with top-efficiency machines, are the only levers which can further increase our national income. While accomplishing this goal, they will continue to lower consumer prices and step up employment, yet yield a satisfactory profit to stockholders . . . for such a system invariably encourages production. Production, plus the ability of consumers to buy, assures high-level employment.

There is no doubt, then, that the historians who will record our times will forget the confused thinking of some of today's missionaries of impractical idealism who haven't bothered to acquaint themselves with the most rudimentary of economic principles. Time's archives will prove that, since wheeled vehicles were devised and horses and oxen were first used as draft animals, man's inventions have not only bettered his way of life but have increased both his income and employment.

Am Sargent

President 1946-47

A Symposium

Plant Layout and Material Handling*

Wherein the Authors Present Case Studies Broadly Applicable Throughout Industry

Fitting Factory Layout to The Product

By Andrew W. Kramer, Jr.

In July, 1943, a committee was set up in the General Electric Company's Air Conditioning Department to determine the facilities and manpower needed for the manufacturing of its postwar equipment, given the quantity of each item to be produced and its net selling price.

This paper covers procedure used in studying modest sized operations averaging about 100 direct workers per line of equipment. The typical units involved contain approximately 500 different parts to be fabricated or purchased. Items that duplicate themselves are counted as one of the list of 500.

***Andrew W. Kramer, Jr.*, was graduated from University of Michigan, 1928, with degree B.S. in E.E. Entering General Electric Co., he spent 8 years in the Fractional HP Div'n, Fort Wayne, Ind., in motor design, application and sales. Later, he was transferred to the Air Conditioning Dep't, Bloomfield Works, and for the past several years has been Engineer on Special Assignment.**

Early study brought up the problem of decentralization of manufacture—i.e., should all operations be placed in one plant or should several plants, properly located with respect to the market and to raw and finished materials be used? And, if a large plant should be the most desirable, should it have a single operating organization, with contributing departments, or should it be decentralized as completely as possible?

It became apparent, after some months, that usual avenues of approach to this problem—i.e., the use of over-all factors of square feet per direct worker, machine utilization and average overhead rates taken from past experience—would not produce the desired result of predicting the factory performance on a going basis. In fact, a complete factory set-up was made, on a contributing department basis, to manufacture all lines of equipment, but, while it was possible to obtain the proper number and kind of machines, true cost of a product could not be obtained.

The contributing departments became large and unwieldy, involving extra handling, increased use of nonproductive workers and also involving excessive paper work. Accordingly, it was decided to make detailed studies, by lines, leading to the required size, capacity, location, operating organization and total capital lockup required for a factory to produce a given line. When operating cost details, plus material and labor, were accumulated for a given sales volume, true cost of the product could be determined unaffected by its companion equipment.

The approach adopted—namely, that of studying factories by lines—led to particular solutions of these several problems for each of the lines considered. Once a factory was known for a given product, a basis of comparison had been created. This idealized plant could and was combined with others in existing or proposed factories and, in a matter of a few weeks, comparative results were available in terms of cost, capacity and capital required.

It also became apparent that certain basic criteria would have to be established in the interest of consistent results. The more important of these being:

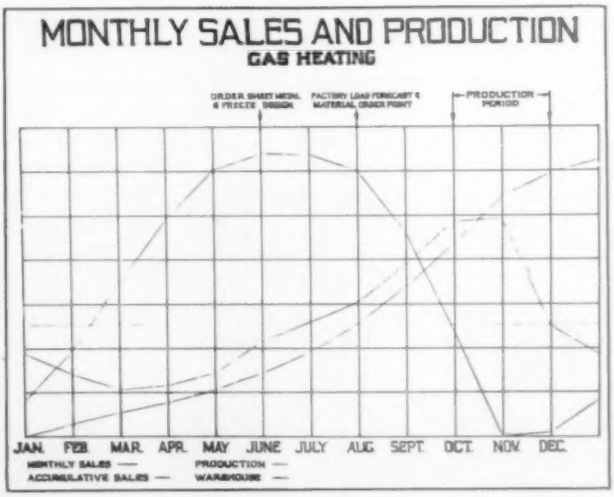
1. Each line of equipment to be self-supporting. 2. No capital additions to be made except where the result led to lower over-all cost after having considered all possible factors such as cost of ownership, maintenance and cost of floor space occupied. 3. The maximum capacity of the plant to be determined on a basis of machine utilization rather than a single shift basis.

Sales Set the Pace

Business begins in the Sales Department; so do factory operations. Accordingly, it was necessary to obtain the cooperation of the Sales Department in determining the number of times per year that the manufacturing rate would be changed. From this, manufacturing cycles were established and dates set depending upon the required lead time for material beyond which no design changes could be affected by the Engineering Department for a given production cycle.

To implement this need, a factory load forecast group was set up, in each sales section, to report to production coordination committees at monthly meetings. Sales, engineering and production are represented and all schedules worked out to three production cycles beyond the date of

FIG. 1. Monthly sales and production.



*Resume of papers presented at the 14th annual meeting, A.S.T.E.

the meeting, as shown in Fig. 1 with four different colors used, one for each line. The rates for the third cycle beyond the meeting are tentative and are used only for the purpose of ordering material with the longest required lead time. The rates for the second cycle beyond the meeting are final, the rate for the first cycle having already been frozen at a previous meeting.

Flow Chart Determines Layout

The next step in the analysis was to find out, in complete detail, the required floor space for factory and warehouse, the required machinery and equipment, the number and kind of direct workers and type of building needed. This was accomplished by means of a flow chart developed for the purpose. This chart, see Fig. 2, plotted the path followed by each and every piece of a given product from the time of its entrance to the factory and to the assembly line and finally to the warehouse or shipping point. The chart included not only the material used in the complete assembly but also shipping materials and all contributing material.

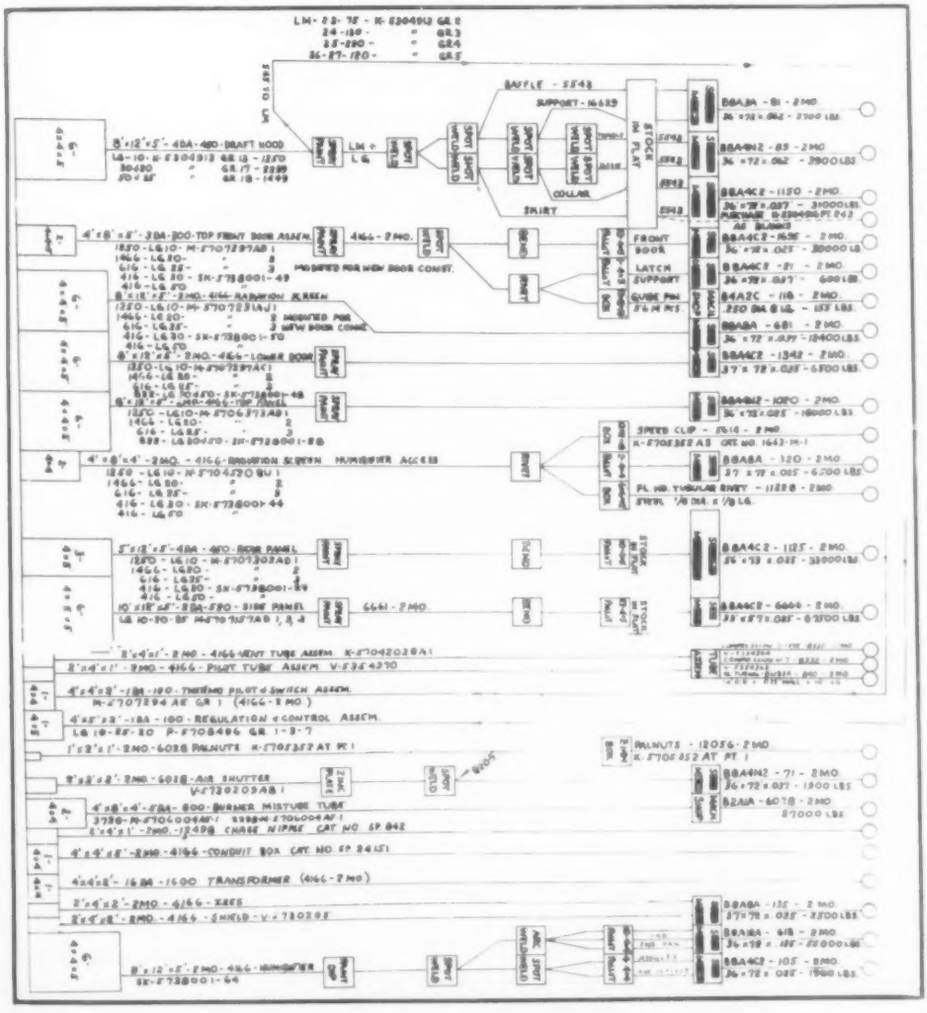
The chart included information regarding the weight and car loads, number of pieces, description, specifications and floor space occupied by all material received for one production cycle. In addition, the area required for work in process before given machines or loading points for the maximum production were indicated.

All so-called general or special stock rooms were eliminated and every part required was placed along the assembly line in proper location and quantity and floor space was provided. The only stock area created was one adjacent to the main assembly line to hold in necessary quantity the few purchased items whose bulk would make the assembly line unnecessarily long. While the chart did not build up, directly, to a factory layout, it was found that in every case all sub-assembly lines could be and were laid out to scale on the chart. Thus, one of the major items of layout was accomplished at the time the chart was completed.

The number of internal transportation trips necessary to move the material from one point to the next were indicated on the chart and, in each instance, a decision on how material was to be handled for a given move was made on a cost basis. The most economical number of production runs per production cycle for machines having costly setups is included on the flow chart after balancing the cost of the setup against the additional floor space required for material for longer runs.

When the chart had been completed, all like stations—such as sheet metal shop—were located on the same horizontal line across the chart as were other fabricating shops, welding and finishing departments. These were then picked up and the individual analysis of the work performed in each of these shops was completed.

Summary sheets were prepared for each shop, showing for each the part number, the number of pieces to be processed, operations to be performed, total time including setup for each operation, machine to be used, per cent machine utilization and the internal handling trips, all for one production cycle. This resulted in a total labor, machine utilization, transportation and capital machine investment picture for each of the shops feeding a given assembly line. Fig. 3 shows, in part, typical machine utilization and capital investment for a given line.



The order established for the final analysis of the flow chart was to start at the warehouse and work back. First, data was prepared and tabulated showing the number of cars of finished product to be shipped, the number of pieces required, the kind and amount of equipment and floor space needed. Next, the packing of the product was analyzed, obtaining a figure on the number of packers required and the number of shifts they would operate at maximum capacity. Note that material and transportation data was already available from the flow chart.

This is followed by production repair when required, then final inspection and final test. In each case calculating from the planning the required people, floor space, kind and cost of equipment. Following this is an analysis of the main assembly and then sub-assembly, each being tabulated to show the number of assemblers, the area required and trips to the line. As was pointed out, this is available from the flow chart. The remaining items in order were finishing department, plating, welding, sheet metal, machine and finally any special shops peculiar to the given product.

FIG. 2. Typical section of flow chart.

Within each of these shops the maximum floor area needed for each machine was included in the particular analysis. This area was determined not only by the size of the machine itself, but also by determining the space to store its work in process taken from the particular piece that required the maximum of such space. In some cases, an additional area was allowed, in proper amount, for material that would be held in temporary storage ahead of such machines as brakes or draw presses where the piece leaves the machine in several production runs per cycle but the entire lot arrives from previous fabricating points in one run per cycle in the flat thus occupying a minimum of floor space.

In these cases, the cost of floor space so utilized was compared with the increased setup cost required for previous operations to make certain that such use of floor space was justified. In each of these departments the purchased material was located in space, in or adjacent to the work area, at a point near the machine performing the first operation.

Work Islands Adopted

With this much information available, a factory layout was prepared. The flow chart showed the order in which the various shops were to be located for minimum transportation. Within a given shop, machines with their allocated space were located in the best possible order. In general, after many studies, the idea of work islands, surrounded completely by aisles, was adopted since it seemed to be the only plan that would give each machine operator the minimum of interference from adjacent machines. Each machine was arranged in the island to allow its material to be brought in, processed and removed without interfering with the operation of adjacent machines.

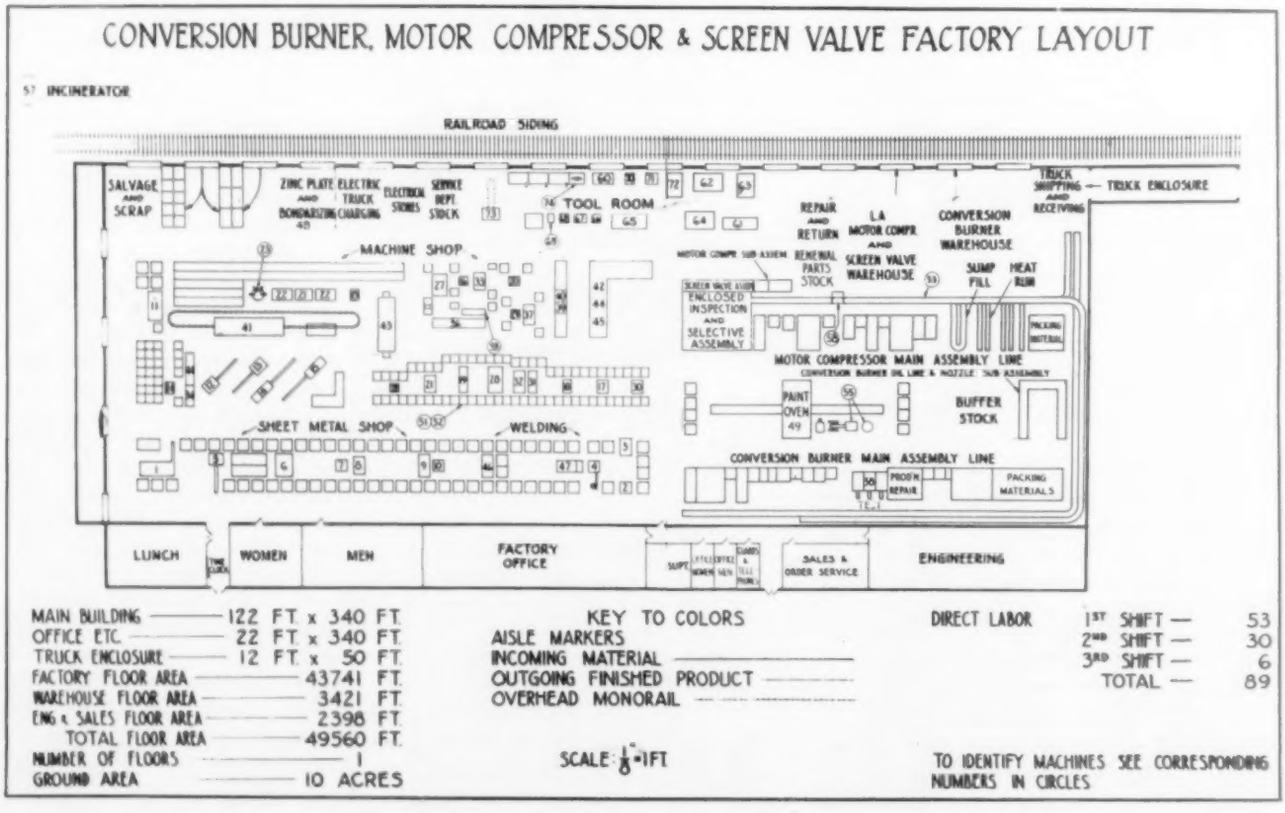
Included in the study of floor space required, is an item of space required for receiving and shipping of materials.

CAPITALIZED MACHINERY
OVENS AND EQUIPMENT
GAS HEATING

	SHEET METAL SHOP-UTILIZATION-	COST LC	COST LM	COST TOTAL
1 1-8' SHEAR	95.5 %	3700	300	4000
2 1-BLISS MULTIPLE [illegible]	77.7	2900	100	3000
3 1-#3½ NIAGARA PUNCH PRESS	72.5	1700	300	2000
4 2-#21 B BLISS PUNCH PRESS	65.5	1800	1800	3600
5 1-5-60 BLISS PUNCH PRESS	30.3	7100	400	7500
6 1-BLISS 58 GAP PRESS	8.0	—	2500	2500
7 1-4' BRAKE CINCINNATI	90.5	2975	25	3000
8 4-6' BRAKE CINCINNATI	79	12000	4000	16000
9 1-4' POWER ROLL NIAG.	26.6	675	75	750
10 1-NIAGARA ROTARY SHEER	3.1	—	1200	1200
11 1-NIAGARA BEADER	14.7	675	75	750
12 1-FAN SCROLL FORM FIX.	25.0	AAE	—	AAE
		33525	10775	44300
LM BOILER SECTIONS				
13 1-MOLINE MULTIPLE DRILL 2 SPINDLE	46.6		9000	9000
14 1-SECTION ASSEM. FIX.	19.0		1500	1500
15 2-PRENTICE VISE	8.5		1000	1000
16 1-BLACK & DECKER COL. DRILL	5.0		500	500
			12000	12000
MACHINE SHOP				
17 1-#000 B&S MILLER	6.4	425	575	1000
18 1- CINCINNATI [illegible]	12.2	3000	1000	4000
19 1-#00G B&S 3" AUTO. SCREW	29.0	3100	900	4000
20 1-#2G B&S 1¼" AUTO. SCREW	50.3	5575	425	6000
21 1-#3 W&S 1¼" HAND SCREW	64.2	2800	2000	4800
22 1-#5 W&S 2½" HAND SCREW	76.6	3950	3050	7000
23 1-#12" MONARCH PRODUCTION LATHE	15.0	—	3500	3500
24 1-#4 STARK BENCH LATHE		675	525	1200
25 1-R-53 HISPEED HAMMER DRILL PRESS	3.0	150	25	175
26 3-#1 LELAND GIFFORD 1 SPINDLE DRILL PRESS	54.0	1400	700	2100
27 1-#2 TYPE KH ALLEN 2 SPINDLE DRILL PRESS	77.8	600	400	1000
28 1-#2 LELAND GIFFORD 2 SPINDLE DRILL PRESS	15.0	—	2700	2700
29 1-AVEY MULTIPLE 18 SPINDLE DRILL PRESS	13.1	4500	—	4500
30 1-21" CINCINNATI BICKFORD TRIPINDLE DRILL PRESS				
3-DRILL PRESS CLUSTERS FOR 21" CINCINNATI BICKFORD		1000	200	1200
31 1-WASHING MACHINE	2.3	2500	500	3000
32 1-#107 GRANT RIVETER	8.9	440	310	750
33 1-#1 CRABB CIRCULAR SAW	16.6	750	50	800
34 1-TUBE MASTER TUBE & FLUE	35.6	225	25	250
35 1-#10 BENCH GRINDER & BUFFER BLACK & DECKER	4.0	75	75	150
36 1-BRAZING EQUIPMENT	10.0	150	50	200
		31315	17010	48325

FIG. 3. Capitalized machinery.

FIG. 4. Conversion burner, motor compressor and screen valve factory layout.



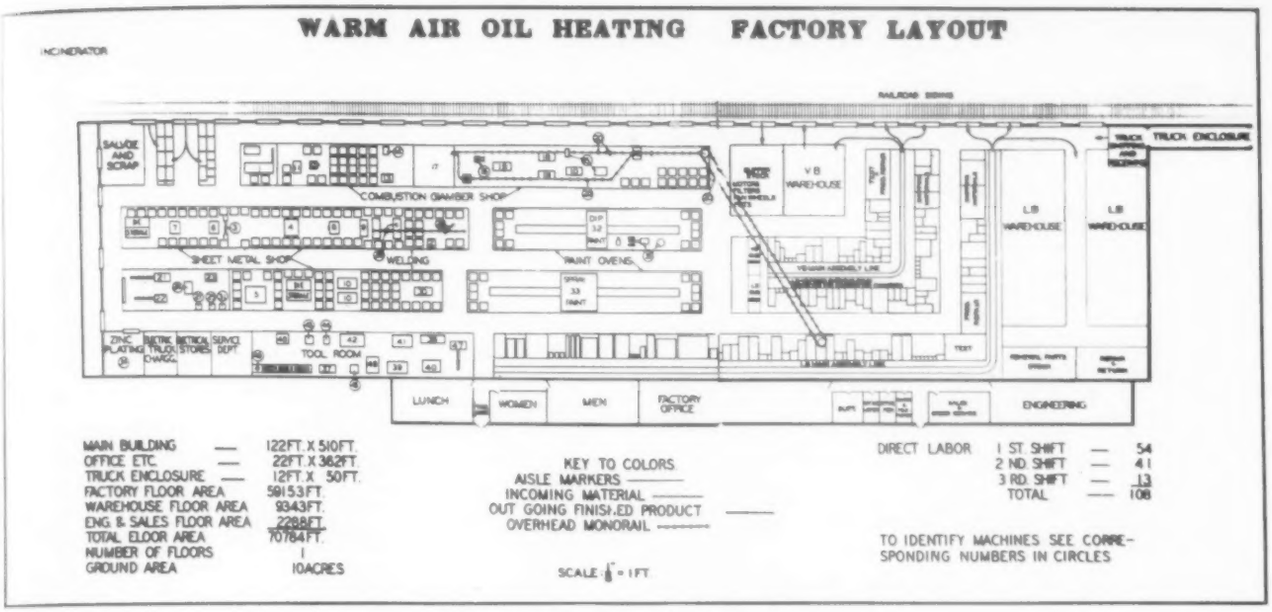


FIG. 5. Warm air oil heating factory layout.

Where known, the sales curve, along with estimated percentage of the product to be shipped by freight and truck, are used to determine the maximum loading space required. Typical factory layouts are shown in Figs. 4, 5 and 6.

At this point, with the floor space required and type of building needed, plus all machinery and direct workers known, it was possible to build up the requirements for the needed operating oragnization. One rule adopted was that a salaried foreman would be provided for each 20 direct workers. Since all information regarding internal transportation had been tabulated the number and kind of these workers and their helpers are known. All other supporting workers are assigned according to the particular needs of the product under consideration. Fig. 7 shows the organization needed for one particular line of products.

Having tabulated machine utilization, a statement of the distribution of workers over the three shifts is given for full rate. At this point, the actual annual cost of the supporting organization is determined, along with all the other elements of overhead including plant and machinery depreciation, power, heat, non-durable tools and shop supplies. This figure is calculated at both full and half production rates so that shop cost of the product will be known in the event of business slumps or slow downs from other causes.

By a method similar to that used to determine the center of gravity of a body, the factory is given an ideal location; suitable weight being given to percentage of sales by areas and location of purchased material. A center of market is first established and then a center for purchased material. The ideal location is assumed to be in an area along the line connecting the two points. If these happen to be widely separated, special studies are required before recommending final location.

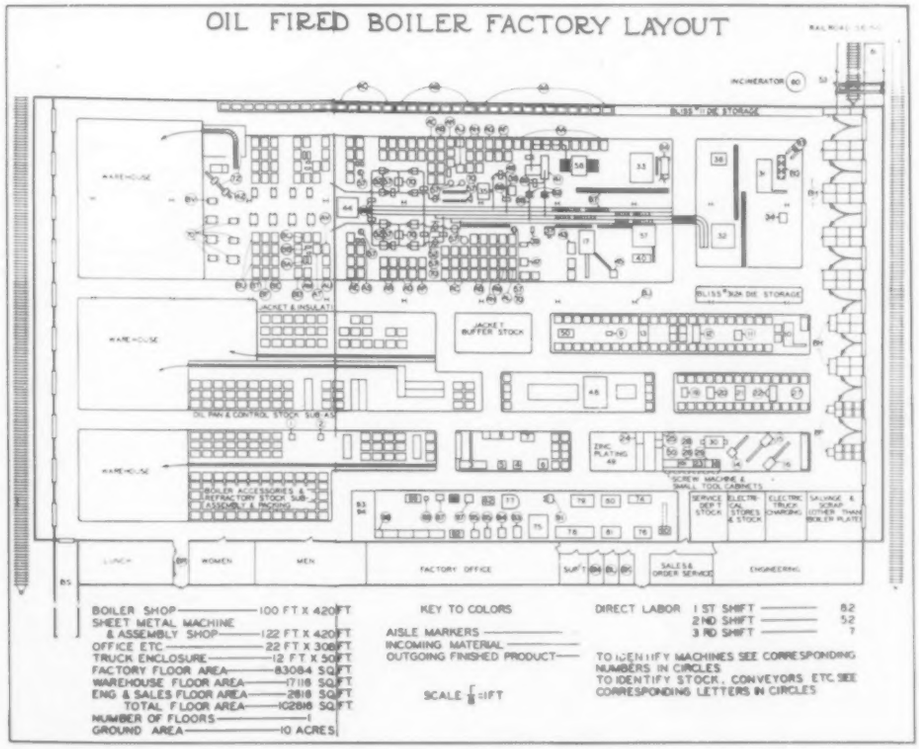

OIL FIRED BOILER FACTORY LAYOUT
RAILROAD SIDING
INCINERATOR
BLISS 75 TON DIE STORAGE
WAREHOUSE
JACKET & INSULAT.
JACKET BUFFER STOCK
OIL PAN & CONTROL STOCK SUB ASS.
ZINC PLATING
SCREW MACHINE & SMALL TOOL CABINETS
BOILER ACCESSORIES & REFRACTORY STOCK SUB ASSEMBLY & PACKING
SERVICE DEPT. STOCK
ELECTRIC STORES & STOCK
ELECTRIC TRUCK CHARGING
SALVAGE & SCRAP (OTHER THAN BOILER PLATE)
LUNCH
WOMEN
MEN
FACTORY OFFICE
SALES & ORDER SERVICE
ENGINEERING
BOILER SHOP — 100 FT X 420FT
SHEET METAL MACHINE & ASSEMBLY SHOP — 122 FT X 420FT
OFFICE ETC. — 22 FT X 308FT
TRUCK ENCLOSURE — 12 FT X 50FT
FACTORY FLOOR AREA — 83084 SQ.FT
WAREHOUSE FLOOR AREA — 17118 SQ.FT
ENG & SALES FLOOR AREA — 2818 SQ.FT
TOTAL FLOOR AREA — 102816 SQ.FT
NUMBER OF FLOORS — 1
GROUND AREA — 10 ACRES
KEY TO COLORS
AISLE MARKERS
INCOMING MATERIAL
OUTGOING FINISHED PRODUCT
SCALE 1/8" = 1FT
DIRECT LABOR 1 ST SHIFT — 82
2 ND SHIFT — 52
3 RD SHIFT — 7
TO IDENTIFY MACHINES SEE CORRESPONDING NUMBERS IN CIRCLES
TO IDENTIFY STOCK, CONVEYORS, ETC. SEE CORRESPONDING LETTERS IN CIRCLES

FIG. 6. Oil fired boiler factory layout.

A calculation of work in process is now prepared from the material analysis on the flow chart, and the known direct labor and overhead cost. This, with a finished stock figure taken from a 12-point average of the warehouse curve, gives the complete capital lockup for the factory.

For the factory thus studied, a report can be made giving complete details after engineering, commercial, and administrative expenses are accumulated. These, along with required cash on hand and accounts receivable, lead to a final statement of total cost and total capital lockup. A summary of all this information results in a final report of the

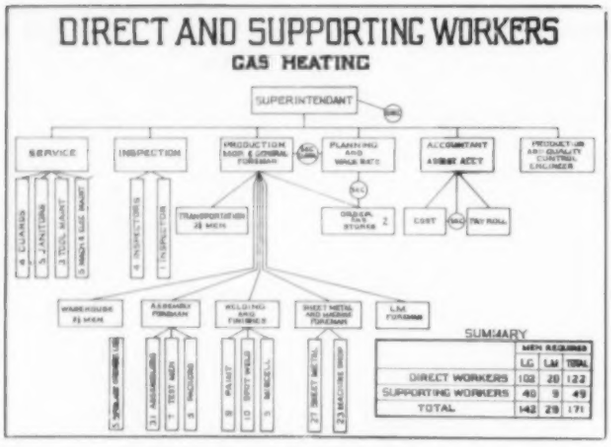


FIG. 7. Direct and supporting workers.

operation as a business. Experience indicates such a report is adequate as a measure of the possibilities in any one line.

During the time that all of the detail work is being prepared for a given project, it is recognized that the final factory loading that would be experienced in actual practice would be something different from that assumed. Accordingly, all data is prepared on the basis of the factory operating at full capacity and at one-half of full capacity. This proves to be a rather important part of the study, since in many cases the overall operation proves to be unprofitable at lower production rates.

Where a conflict exists between two sales analyses, for a given product, sufficient capacity is allowed to enable the factory to produce on the schedule calling for the maximum of facilities.

It might well be asked if cost reduction should be considered along with these studies. The procedure outlined made no effort to reduce labor or material below that required by the designs submitted for analysis. However, a reduction in certain types of overhead cost is indicated frequently in such analysis as we have attempted. On one given device, for example, an analysis of its prewar manufacture showed that its punch press parts were being produced on thirty different presses located in three widely separated plants. Actually, all this work could be completed on four presses located in a single department devoted exclusively to the job at hand. The estimated transportation savings in a single year would pay for the largest of the four presses.

Plant Layout and Material Handling Studies

By Haylett B. Shaw

ONE OF THE MOST pressing problems faced by American industry is the preservation of our life line—that difference between cost of manufacturing and income from sales—which is the artery through which the life giving fluid of profits flows. The choking of that artery, by rising labor and material costs on the one hand and fixed selling prices on the other, is a challenge to all types of engineers, including Tool Engineers and Methods Engineers.

The urgency of the problem is beginning to appear on the financial pages of our daily newspapers, where we see notices of passed or reduced dividends and, even today, reports of occasional deficit operations, most of which are attributed to the price squeeze. Then, there is another factor which makes the challenge of manufacturing at a lower cost of vital concern to all of us. If the increased wages which are being given today are used as justification for proportional price increases, then we have gained nothing and, in fact, have lost a large portion of the purchasing power of our bonds, savings and life insurance.

The Tool Engineers of America have earned the gratitude of the nation for the manner in which they tooled up our country for the most remarkable production program in the history of the world. Today, we need the same enthusiasm and ingenuity applied to the problems of lower cost production.

It is generally recognized, in the engineering profession, that there is no one best way of performing an operation. It seems that no matter how much improvement is made on a machine, further study will inevitably bring about even more improvement. Yet, if we are to combat successfully the problems we have been talking about, our efforts must be directed to these points in our industrial machine where we will get maximum results in a minimum of time.

It has been said that we are beginning to reach the point of diminishing returns in the design of semi-automatic and automatic machines because of the problems of supplying raw materials and removing the finished goods from such high speed equipment. Those facts suggest that the next logical campaign in the program of more efficient industrial operation should be directed toward the reduction of material handling costs.

After graduation from college, *Haylett B. Shaw* spent several years with Commonwealth Edison Co., Chicago. Following this, he planned and constructed a warehouse, for the Fox-Vliet Wholesale Drug Co. (of which he subsequently became General Manager), in which emphasis was placed on materials handling. Since 1942, he has been a staff engineer with the Methods Engineering Council, Pittsburgh, and has been active in supervising and training engineers in material handling methods.

The results which may be obtained by channeling our efforts in this direction are obvious when we recognize that material handling is the greatest single item of manufacturing labor cost today, accounting, according to Alford, for 22% of the total cost of manufacturing. Looking at it another way on an industry wide basis, for every ton of finished materials shipped, the equivalent of fifty tons of material have been handled within the plant.

Studies by recognized authorities show that the number of times a unit is handled in a plant ranges from 20 to 150. Most of these handlings occur while moving and positioning materials for the processing and assembly operations to which we have all concentrated most of our attention in the past. We must now regain our perspective and recognize the opportunity which awaits us in the field of material handling.

Do not infer, from what has been said, that aggressive programs in this direction are not already under way, in some plants, where attention is being focused on standard unit packing procedures, elaborate conveyor installations and incentives for material handlers. You have probably seen the new magazine—"Flow" on material handling—which is devoted to this subject, and perhaps you have read in newspapers of the organization of "Material Handling" societies in your city.

The military forces attracted much attention as they ettled to move unheard of quantities of materials with peed to all parts of the world. Their extensive experience the use of pallet loading has injected a new trend into aterial handling planning.

Then, as further evidence of the awakening we are having this field, we need only look through magazines such as Factory Management and Maintenance," and "Modern Industry," to observe the increasing number of manufacturers bringing out new items designed to simplify material handling operations.* The responsibility of making use of these new products and ideas, however, is still primarily up to us who must plan and adapt them to the needs of our individual plants.

Effective Layouts

So far, although we have talked exclusively of material handling, we cannot divorce this from the subject of plant layout, for any improvements we make in material handling methods are likely to affect our layout and, conversely, layout changes will most certainly have a major influence on material handling costs. To show how closely these two subjects are related, let us turn from theory and generalized statements to some specific examples. These examples have been taken from a variety of industries, and are presented here to emphasize, from a cost standpoint, how important it is for effective layouts to be installed and for material handling methods to be improved.

These cases have been placed in two groups. First, those which pertain to material handling problems at workplaces; and second, those which concern the movement of materials to and away from the work areas. Since, in the past, the work of the Tool Engineer has been principally directed to the problems of the production area, let us consider that phase first.

In one plant, which manufactures an extensive line of gas hot water heaters, a beautifully designed drill press is used to drill the gas ports, those small holes on top of the burners. For years, this work was done by a group of girls who were supplied with big barrels of burners, and who would slip off their chairs, reach down into the barrel for four to six burners, climb back onto their chairs, and drill holes until they needed more burners, when the process would be repeated.

Study of the material handling aspects of the operation revealed that not only was utilization of the machine being reduced, but the girls were greatly fatigued by the bend, long reach, and heavy lift. When the boxes of burners were positioned at the working level beside the drill press, production increased 40% and the girls were much happier. This type of condition is not uncommon in many plants where workers have become calloused to excessive handling efforts, and management has not given material handling at the workplace the same careful study it has given the selection of the machine to be used.

In the ladies' dress industry, it has been standard practice, for a long time, to cut several bolts of material simultaneously into sleeves, bodies, and skirts of a given model. However, since bolts of material vary in color and shade, the pieces cut from each bolt have to be kept together and are carefully bundled and moved into a storage area. When an operator is ready for work, she leaves her machine, goes to the bins, takes a bundle and, let us say, shirrs all the sleeves in the bundle, ties it up, and returns it to the bins. Other operators work in a similar manner.

Assembly Line Procedure

It can readily be seen that the process is largely one of getting and returning bundles of materials. By changing the layout in the department, and lining up the machines beside each other in their proper sequence, it was possible to establish an assembly line procedure in which a bundle of material would be put in process once and, as each operation was performed, the operator would set her finished piece aside where it would be handy for the next operator to pick up. The net result of the layout changes and reduction in material handling was increase in production of nearly 75% and an appreciable saving of floor space.

*The Tool Engineer *also includes material handling equipment among the tools for mass production and, as these and other articles attest, publicizes both equipment and methods.*

FIG. 1. A typical material handling operation in which two men move cartons of material to an assembly line, one unit at a time. A third man is needed to unload at the other end of the conveyor.

FIG. 2. An improved method of doing the same type of handling shown in Fig. 1, but with only one worker required to move much larger quantities of materials.

In another plant, manufacturing gas masks, the last operation of a long assembly line was the nailing on of the lids and the banding of shipping cases, weighing over 200 lbs. The boxes were then lifted by a pair of husky men onto skids for movement to the shipping department. As activity increased toward the end of the war, this became a very burdensome handling operation, and was finally largely replaced by wheeling the cases away on dollies and storing them until a whole new crew came on after regular working hours to load the cases on skids.

Simplified Handling

The installation of a ½ ton Budget hoist, with special lifting hooks, made it possible for one man to do the whole operation, including loading of the skid. This not only saved manpower, but recovered some much needed floor area. It is an interesting example of the work of the Tool Engineer applied to the problems of material handling.

Another well engineered piece of material handling equipment, used in the same plant, was a continuous chain conveyor with hooks designed to carry gas mask canisters from one operation to another and from one floor to another. Prior to its installation, wooden racks holding a dozen canisters on pegs would be pulled off a belt conveyor by operators who would life off the canisters, apply filter paper or a rubber sealing compound, and return the canisters to the rack.

When returning the completed rack to the conveyor it was necessary for some girls to stand up to make the long reach with the heavily loaded rack. At the end of the process on one floor, the loaded racks were placed in specially designed tote carts. These were then wheeled by a crew of material handlers onto elevators and to another floor where the process continued.

The material handlers, of course, had to load the emptied racks in the carts, return these to the first department, unload them at the start of the line, and then go to the end of the line for a new load. The installation of properly designed material handling equipment, in the form of chain conveyors, made it possible to increase production by 50% because of reduced handling operations and the release of floor space formerly required for handling equipment.

FIG. 3. A modern packing bench which provides cartons, padding, wrapping paper and other supplies within easy reach. The packer never lifts the finished package, but only moves it aside on a conveyor leading to a gravity chute.

These examples are typical of what can be accomplished on the production floor when the same concentrated study is given to the movement of materials, to and away from the workplace, as is given to the design of the tools used at the workplace. If we step away from the processing and assembling departments, we go into a field in which equally great opportunities exist for worthwhile savings. A good many of the 20 to 150 handlings given each unit in a plant occur in the receiving, trucking and shipping operations.

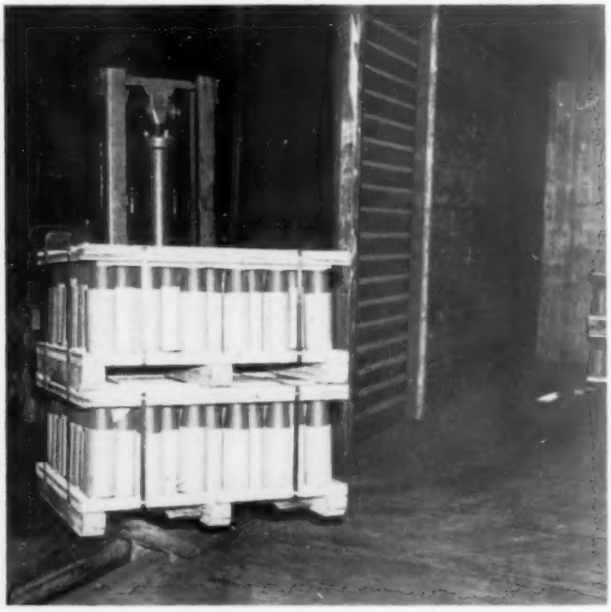
In the receiving department, for instance, it is common practice for trucks to unload onto a dock, where the material is nominally checked, after which it is handled onto skids and moved to an inspection division which rehandles it, after which it is loaded onto an elevator and trucked to a storeroom where it is rechecked, unloaded from the skid, and perhaps put into bins. Then at a later time it is reloaded onto skids and taken to the production department where it is unloaded from the skids at the proper workplace.

One cosmetic plant, seeking to avoid such repetitious handling, installed a series of belt conveyors leading from their unloading dock to each of the several floors of the building, much like a series of escalators. When a truck is to be unloaded, a gravity roller conveyor leading to the belts is pushed up to the end gate of the truck. The receiver then starts the conveyors between floors, goes to the proper floor, positions a guide to divert the cartons off the belt, and unloads them onto a skid right in the proper manufacturing department, checking quantity while he works. Movement of the skid a few feet to the production line completes the operation.

Of course, this procedure cannot be applied in every plant, but there are undoubtedly many places where it could be used, and where no particular thought has yet been given to it. In the case cited, the whole plant was laid out around the incoming and outgoing conveyors—and material handlers are exceedingly difficult to find.

Contrast this with a feed mill, handling hundreds of tons of grain daily and employing dozens of men to wheel hundred pound sacks on stevedore trucks out of cars and into the warehouse where the bags are neatly stacked today, then removed tomorrow to be dumped into processing bins at

FIG. 4. Pallet loads of material are moved into freight cars with one handling, using a power lift truck. Return of the empty pallets is another materials handling problem.



the far end of the building. The labor savings which that firm could have made would amount to 80% if it had constructed the mill so that the bins would hold the fifty tons received in a car, and had then located the conveyors to the bins near the tracks so that a couple of men, working inside the cars, could unload them directly onto the conveyors. This is one instance where unplanned plant layout is costing thousands of dollars monthly in unnecessary material handling.

For a final example, look to your shipping department. Do you find packers doing a good job, but having to run into the office to get bills of lading prepared? And, while this is being done, are cartons and cases scattered helter-skelter on the shipping floor?

It frequently happens that packers set their finished products aside with one handling, a freight clerk then handles them while looking for other materials, and they get a third handling when they are finally moved to the loading dock. One progressive manufacturer reduced his packing and shipping costs—and that means material handling costs—by 51% when he changed his layout to that of a production line.

The packers pack right on subsidiary wheel conveyors, and push their completed boxes onto a belt conveyor which moves to a scale fitted with a roller platform. A bill of lading typist sits right beside the scale and is part of the line. The freight clerk lifts the units only once, and that is when he lifts them from the conveyor onto the skids which have been specifically designated for each of the several transportation agencies serving the company.

The writer has gone into this list of actual cases to show how much can be done and how profitable a study of these problems can be. It must be kept in mind, however, that plant layout problems have many different aspects, and that each layout must integrate many different functions of the organization according to their importance in the particular department under consideration.

Minimum Material in Process

Not only must materials move over the shortest possible distances, but they must move in such a way that operators need do only a minimum of lifting. There must be the least amount of material in process at all times, and it must be possible to accurately check the number of units processed at each of the workplaces.

As Mr. Manuele* has pointed out, the inspection and quality control function is vital and must be provided for. Consideration must be given in any layout, not only to the use of the most efficient machines available, but also the manner in which the production of these will synchronize with the output of other units in the process. It frequently happens that high speed machines only create additional material handling when they can produce a days work in four hours, and the production of other units must be backlogged or banked for them. Balancing of machine loads is too often neglected.

It is exceedingly important, when considering the value of layout and material handling improvements, to plan carefully who is going to be responsible for these factors. All too often the layout of production operations, and the establishment of material handling procedures, are left to the already overburdened foreman or supervisor who must think up something fast to answer needs of the moment. That is not much different from asking him to design a new piece of machinery for one of his operations. He undoubtedly has good ideas in both instances, and can make worthwhile improvements over present procedures, but that will hardly qualify him to assume responsibility for an intensive investigation.

Rather, if results are to be obtained which will appreciably reduce costs in a systematic manner, the problems must be placed in the hands of specialists who, with stop watches, slide rules and flow charts, will make a comprehensive analysis. Then, knowing what has to be done, and how long it takes to do it, a proper routing of materials can be made. Likewise, the most effective types of equipment can be located with respect to one another so that the handling and rehandling of materials will be minimized.

Probably most of *The Tool Engineer* readers represent firms which have postwar building plans. Yet, in how many instances have detailed analyses and layouts been made for those new additions? For, how can gravity chutes, elevators, conveyors and other material handling devices be most effectively located in the building unless such preliminary planning is done before the architect starts his work? The case is something like that of the home craftsman who builds a boat in his basement and then finds it is so large it won't go through the door. True, he gets it out eventually, but only after considerable thought to material handling and reconstruction!

Incentive Plans

Another approach, to savings in the field of material handling, is through the extension of incentive plans to receivers, material handlers, storekeepers, truckers and shippers. It is true, one or two stop watch studies will not provide a basis for such an installation. But the weeks and months of engineering time spent on standardizing methods, simplifying layouts, and studying such operations are well justified. There is the further advantage in such a program of giving recognition to those so-called "forgotten men" of industry, who have not been able to participate frequently in the production bonuses paid those workers who are known as direct laborers.

To give you an idea of the tangible results which can be gained from such studies, there is a warehouse in Pittsburgh which receives, stores, and ships hundreds of different materials, varying from small nuts and bolts to 100 lb. sacks of chemicals and ton units of sheet metal. Layout improvement methods, standardization and an incentive plan made it possible for an eight man group to turn out three times as much work as they had ever been able to do before.

A similar installation in a smaller storeroom made it possible for two order pickets and packers to produce four times their previous limit. That is why intensive study of plant layout and material handling operations offers one of the most promising means of taking some of the "water" out of that 22% material handling cost in the goods we make today.

A final means of reducing handling costs is through encouraging programs, now being initiated by some firms who are working out methods with transportation agencies, for the use of pallets and other standard shipping units for goods moving between suppliers, manufacturers and customers. These have tremendous possibilities for material handling savings and are worthy of all the aid and study given them.

It is readily conceivable that, in the not too distant future, many of your bulk shipments may be strapped onto pallets and moved as unit loads into or out of cars by fork trucks as single units, rather than as 100 cartons, or 20 bags of grain, or four 55-gallon drums of paint, thereby effecting not only major reductions in material handling but also a substantial increase in effective floor areas. Materials

**A New Approach to Statistical Quality Control, August, 1946*, The Tool Engineer.

packed in this manner may be tiered three and four levels high by lift trucks, instead of being spread all over the floor.

In summary, then, we are faced today with the problem of reducing production costs. Carefully planned plant layouts and material handling studies offer one means of answering a part of this problem. Such programs will prove most profitable if they include the following steps:

1. An increased emphasis on the part of Tool Engineers on the development of equipment which reduces material handling, both at the workplace and in the rest of the plant.

2. The designation of properly qualified methods, layout, or material handling engineers to be responsible for carrying out the program. 3. The design of new buildings around the operations they are to house, rather than fitting the operations to the buildings after they are erected. 4. The application of incentive standards to standardized material handling operations. 5. The playing of an active part by the company in those programs which will simplify the movement of materials by common carriers.

We have fought on foreign battlefields to preserve the American way of life, now we must win the cost battle on the home front if our system of free enterprise is to survive. Improvements in the layouts of our plants, and in the methods used in handling of materials are logical and profitable means of meeting this objective.

By Karl Stad

Electronic Tachometer Facilitates Time Study

Of especial interest to time study engineers is a new Electronic Tachometer, announced by the Special Products Division of the General Electric Company. Weighing only 19 lb., and designed for measuring rotating speeds from 300 to 50,000 rpm, the new tachometer is useful for the production testing of equipment, instantaneously, without need for any permanent attachments. It will instantly indicate the speeds of electric motors, machine tools, automotive and aircraft engines, pumps, fans, blowers—in fact, practically any type of rotating equipment.

The instrument consists of a small pick-up head, six feet of flexible cable, and a measuring unit with a panel-mounted indicating instrument reading directly in rpm. Either a low-speed or high-speed head can be used, the former providing five speed ranges—0 to 1000, 0-2000, 0-5000, 0-10,000 and 0-20,000 rpm—while the latter provides three speed ranges, 0-10,000, 0-20,000 and 0-50,000 rpm.

Each pick-up head consists of a light-interrupting disk and a phototube. Light shining upon the phototube through the openings in the rotating disk produces input signals which are then transferred to the measuring unit, which indicates the rpm of the equipment being tested. The shaft to which the disk is attached rotates on ball bearings and requires very little torque; therefore, the speed of the equipment being measured is not reduced by use of the tachometer.

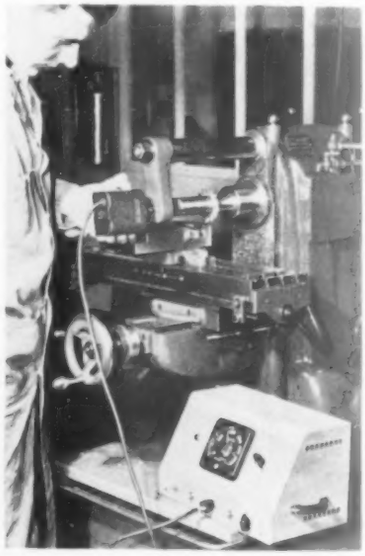
Also, by G-E, is a new lightweight, Inkless Tachometer recorder to provide a record of rotating speed. This instrument is a development of General Electric's Meter and Instrument Division. Designated as the Type CF-3, the recorder is designed to operate with an aircraft-type a-c tachometer generator; however, any a-c generator with suitable characteristics can be used.

Scale range of the recorder is 0 to 3000 rpm. When used in conjunction with aircraft-style tachometer generators, the minimum indicated speed under normal conditions is 600 rpm and the maximum continuous speed is 2500 rpm. Readings are accurate to within 1.5 per cent of full scale, with full-scale deflection obtained in two seconds.

The enclosing case, splashproof and weatherproof, is an aluminum-alloy casting with a pressure gasket between case and cover. Although furnished in portable form, it can be readily mounted on the surface of a wall or panel. Overall dimensions are roughly $5\frac{3}{8}$" x 8" x $10\frac{1}{2}$", weight 12 lbs. Since the record is made, on a 4" wide record roll, by means of a typewriter ribbon, blotting or flooding is not possible. The standard chart speed is 3 inches per hour, and additional rate gears are available for chart speeds of 1 inch per hour, 2 inches per hour, or 1 inch per day.

The instrument is of the magnetic-drag type, in which a synchronous motor, built into the recorder, rotates in unison with the tachometer generator mounted on the device of which the speed is to be recorded. The synchronous motor is not subject to errors caused by temperature changes at the generator, lengths of leads or variations in generator-voltage output.

Below, the G-E Electronic Tachometer used to check spindle speed of a milling machine. The Inkless Recorder is shown in small photo.



50% Recovery Percentage

As announced by H. F. Eckfeld, Detroit Regional Director, WAA, miscellaneous machinery, machine tools and special equipment used by the Ford Motor Company in the manufacture of war material in Michigan, England, France and elsewhere have been purchased by Ford from War Assets Administration for $7,598,209.11.

At the conclusion of hostilities the government entered into an agreement with the Ford company to permit it the use of the machinery and equipment pending inventory survey and final purchase. This arrangement kept the plants in continuous operation and made possible the employment of thousands of workers without interruption. No real estate is involved.

The original cost to the government of the properties involved was $14,206,774.30. The sale price of more than $7,500,000 thus means a recovery percentage of more than 50 per cent, which is well above the average in cases of this kind.

By **The Broaching Institute**

The New Involute Spline Standard

New System Provides for Remarkable Advantages and Flexibility in Design

CULMINATING THE THINKING and development by experts in many fields for almost 25 years, the American Standard on Involute Splines marks an important advance in the simplification of design, in production economy, and in the simplification and standardization of hobs and tools. Since the involute spline standard cuts across the interests of all manufacturing industries, designers and production executives alike can approach its immediate adoption with a feeling of full confidence in view of the long period of consideration and experimental work which preceded this announcement.

Attention is being drawn to the American Standard at this time because the *Standards Manual* has not yet been published by the American Standards Association. However, it has been released for publication and may be available for distribution about the time this article is in print. The standard was developed under ASA procedure and was officially approved by the cooperating bodies—the Society of Automotive Engineers, the American Society of Mechanical Engineers, the American Gear Manufacturers' Association, and the National Machine Tool Builders' Association. Consequently, industry can put the standard to work without delay and with full confidence in the results even though the Manual may not be immediately ready for distribution.

It is significant that the standard is already in use within the General Motors organization as a GM standard and within the Chrysler Group as a Chrysler standard. Moreover, it is expected to be published in the 1947 edition of the SAE Handbook.

ACTUAL SIZE	DP	a	b	p	t_s	t FOR CLASS A	t FOR CLASS B	t FOR CLASS C	PIN DIA. d_x	PIN DIA. d_n
½Diametral Pitch Too large to illustrate	½	.5000		3.1416	1.5728	1.5688	1.5718	1.5743	1.9200	1.4400
					1.5708	1.5668	1.5698	1.5728		
	2.5/5	.2000		1.2566	.6303	.6263	.6293	.6318	.7680	.5760
					.6283	.6243	.6273	.6303		
	3/6	.1667		1.0472	.5256	.5296	.5246	.5271	.6400	.4800
					.5236	.5196	.5226	.5256		
	4/8	.1250		.7854	.3947	.3907	.3937	.3962	.4800	.3600
					.3927	.3887	.3917	.3947		
	5/10	.1000		.6283	.3157	.3127	.3147	.3172	.3840	.2880
					.3142	.3112	.3132	.3157		
	6/12	.0833		.5236	.2633	.2603	.2623	.2648	.3200	.2400
					.2618	.2588	.2608	.2633		
	8/16	.0625		.3927	.1978	.1948	.1968	.1993	.2400	.1800
					.1963	.1933	.1953	.1978		
	10/20	.0500		.3142	.1581	.1561	.1576	.1596	.1920	.1440
					.1571	.1546	.1561	.1581		
	12/24	.0417		.2618	.1319	.1299	.1314	.1334	.1600	.1200
					.1309	.1284	.1299	.1319		
	16/32	.0313		.1963	.0992	.0972	.0987	.1007	.1200	.0900
					.0982	.0957	.0972	.0992		
	20/40	.0250		.1571	.0795	.0775	.0790	.0810	.0960	.0720
					.0785	.0760	.0775	.0795		
	24/48	.0208		.1309	.0664	.0644	.0654	.0674	.0800	.0600
					.0654	.0634	.0644	.0664		
	32/64	.0156		.0982	.0501	.0481	.0491	.0511	.0600	.0450
					.0491	.0471	.0481	.0501		
	40/80	.0125		.0785	.0403	.0383	.0393	.0413	.0480	.0360
					.0393	.0373	.0383	.0403		
	48/96	.0104		.0654	.0337	.0317	.0327	.0347	.0400	.0300
					.0327	.0307	.0317	.0337		

← TOOTH DIMENSIONS —PIN DIAMETERS

NOTE: Bold dimensions are basic

Within the automotive industry, the involute spline is adaptable to any fittings previously using the straight spline. Among the most important applications are: for transmission gears and shafts; for propeller shaft fittings; for axle shafts driving flanges at the wheels, and in the differential side gears.

So far as the user is concerned, the most valuable feature of the new standard comes from the progression of fifteen (15) diametral pitch sizes, ranging from ½ at the top to 48/96 at the lower end of the scale. This encompasses the gamut of commercial shaft sizes from the largest industrial machinery drives to the finest splines for aircraft and small instruments. Another outstanding characteristic is the provision for any desired number of teeth from a minimum of six, for small shafts, to as many as 50 for large shafts. This removes another of the restrictive features of the conventional straight spline standard which held the designer to a selection of 6-10-16-24-36 teeth for all shafts.

The experts who drafted the new standard took another forward step. Designers will be delighted to find that it now gives dimensional tolerances on both the shaft and the hole, thus relieving them of the serious burden of calculating tolerances on elements not covered by the old standard. The tolerances suggested are those current in quality manufacturing, so that the standard has been set for high quality.

Apart from other advantages the standard holds greatest promise from the standpoint of production economy. In contrast to the old standard which provided three depths of tooth—shallow, medium, and deep—the involute spline is based upon a 30 degree pressure angle involute with but ONE standard depth. This means that the entire range of sizes—a range of 15 diametral pitch sizes—requires only 15 different hobs to cover the gamut of applications on all pitches. So far as the user is concerned it permits the stocking of just a limited number of hobs to meet his usual ranges of shaft sizes. Moreover, each hob for a given D. P. can be used to cut all shafts within the D. P. range, regardless of variations in shaft diameter and number of teeth.

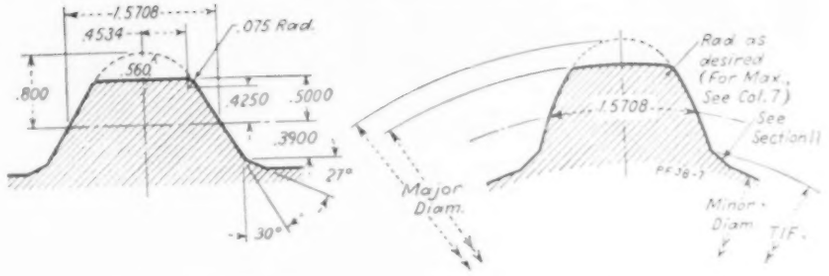
Production men can appreciate the value of such simplification. It permits the suppliers to create a simple but complete line of standard hobs and make them up for stock. This, in turn, means that the user can get hobs out of stock quickly whenever new tools are required. Contrast this with the situation existing today where hobs must be made up specially for each job and require weeks or months for delivery!

A brief review of the background of spline standards may be of interest at this point. The history of the straight spline standard goes back 30 years or more. On the other hand, the principle of the involute spline was being studied in the early 1920's, and it is a matter of record that, around that time, some sliding members for motor car transmissions were being made with a 30 degree pressure angle involute. Nevertheless, the straight spline has persisted through the years and became as firmly accepted as the table of decimal equivalents.

In the course of time, however, people in the motor car industry, and in other lines of industry, began to complain about the shortcomings of the time-honored straight spline. These rumblings could not be ignored. And, in 1929, a committee of the SAE began in earnest to develop an acceptable involute spline standard. But since such work requires time and money, it had to be temporarily abandoned by the incidence of the depression, of which we have poignant memory.

As depression conditions wore off the work was resumed. The committee started afresh in 1935 and, by 1939, had developed the first involute standard. Human nature being what it is, this standard bore the imprint of previous precedent. Because the old straight spline standard called for three different tooth depths, the initial involute spline standard specified three depths. Then, to further complicate matters, the motor car engineers decided that bearing sizes must influence shaft sizes and since bearing sizes were rated in the metric system the standard was written in millimeter sizes for the diameter.

HOBS AND BROACHES



½ DP Hob Tooth

½ DP Broach Tooth

Depth of cut will vary for desired fit.

DP	Outs. Dia.	Width	Bore	DP	Outs. Dia.	Width	Bore
1/2	7.00	9.00	1.50	12/24	2.50	2.00	1.25
2.5/5	4.00	4.50	1.25	16/32	2.50	2.00	1.25
3/6	3.75	4.00	1.25	20/40	2.50	2.00	1.25
4/8	3.50	3.50	1.25	24/48	2.50	2.00	1.25
5/10	3.00	3.00	1.25	32/64	2.50	2.00	1.25
6/12	3.00	3.00	1.25	40/80	2.50	2.00	1.25
8/16	2.75	2.75	1.25	48/96	2.50	2.00	1.25
10/20	2.50	2.50	1.25				

RECOMMENDED HOB DIMENSIONS

The broach design will be in accordance with the specifications given in the tables for internal splines.

The length of the broach is determined by the length of the part, the hardness, the type of material to be broached, and the broaching equipment available.

Dotted outline shows full-fillet type.

Thus was born the 1939 American Standard, but before it was published in official form there came a wave of protests which forced its abandonment and led to the decision to revive a technical committee charged with the development of a standard which would be acceptable to all industry. This work was begun in 1940 under ASA procedure with four major sponsoring bodies—SAE, ASME, AGMA, and the NMTBA. Once again fate intervened, this time by the incidence of World War II.

Despite many disappointments, some progress was made during the war, urged by the demand for improved splined elements for aircraft and for motor vehicles. By the early part of 1945 the committee had reached agreement on what is now the new American Standard. Before the end of 1945 the standard had been published for distribution within GM and Chrysler Divisions; and ASME data sheets were off the press by December, 1945, although not released for general distribution. So far as the automotive industry is concerned, the American Standard was given its official launching at the SAE Annual Meeting in Detroit in January, 1946, by the presentation of the paper, "Engineering of Involute Splines" by George L. McCain, of the Chrysler Corporation.

Marked Design Advantages

While simplified, the new standard provides great flexibility of design practice. It offers three types of spline fits, depending upon the nature of the application—the major diameter fit, minor diameter fit, and side fit. This takes care of every kind of drive condition. Then, for each type of fit, the standard provides three different classes of bits, again in keeping with modern design practice—for press fit assembly, for close fit assembly, and for sliding fit assembly. The combinations of these options give designers a free hand in meeting the requirements of any drive.

The involute spline has other remarkable advantages so far as the designer is concerned. Greatly increased torque capacity is easily the most important of these. With the straight spline it is recognized that there is little guarantee that all teeth of a splined member will carry their share of the load. In fact, there are times when the entire load

may be concentrated upon one or two teeth alone. With the involute, better control of the manufacturing process assures that more teeth carry their share of the load.

Size for size, generally speaking, the involute spline will carry greater load, depending upon shaft size. Consider the implications of this! Where the designer is compelled to work within constrained shaft diameters, the involute-splined shaft gives much greater load carrying capacity with a consequently greater margin of safety. On the other hand, if the margin of safety is ample with the straight splined shaft, the designer has an opportunity to decrease shaft size and to scale down the mechanism correspondingly if he so desires.

The new standard simplifies and improves the entire tooling picture so far as the shop is concerned. We mentioned earlier that it reduces the variety of hobs to a minimum and makes them more readily available. In addition, it permits of a wider use of the broaching process since broaching tools will produce precisely and accurately cut teeth in bores of any type within the range of bore sizes common in the mass production industry.

The broaching process is uniquely a mass production method. The broaching tool is a precision instrument and will produce interchangeable bores at a high rate of productivity. Moreover, the cost of the broaching tool is readily amortized where large volume is involved, thus making tool cost extremely low. It is a matter of common knowledge among production men that the broaching process not only is the simplest from the standpoint of equipment set-up but is the only practiced means for speeding the formation of bores where large volume is involved.

The Broaching Tool Institute, which is composed of the leading producers of broaches in this country, through its membership has aided in the development of the involute standard and stands ready to assist designers and manufacturers in its immediate adoption. Until the ASA standard is ready for distribution the Broaching Tool Institute will be glad to study new or existing product design and to make recommendations as to the changeover to the involute spline. It is prepared to recommend tooth sizes, tolerances, and production practices and, in general, to assist the user in establishing the most economical set-up for the manufacture of involute spline fittings.

By taking advantage of this service, the manufacturer can switch to the new standard surely and economically and will be assured of the fullest economy offered by the broaching process.

For further information on the subject of the art of broaching in all its applications, write for a copy of the handbook—"Broaches and Broaching"—which is published by the Broaching Tool Institute as a public service in the interest of furthering the manufacturing art.

Now that the American Standard has been launched, it is understood that a committee is at work on the development of a revised and modernized standard for straight tooth splines in the interest of those who find this type of fitting desirable. Another group is currently working on a standard for involute serrated fittings, such as are used in the automotive and aircraft industry, along the lines of the involute spline but including a finer pitch then the 48/96 which is the smallest size in the spline standard. It is possible that the serration standard may become a part of the American Standard later on.

The Crush Form Thread Grinder—A Sequel

BECAUSE CONSIDERABLE interest was evinced in the grinder in the article—"Crush Form Thread Grinding—British Method"—by L. H. Rhodes in October issue, *The Tool Engineer*, we wrote to Mr. Rhodes asking for further particulars. His reply follows, verbatim except for parenthetical notes:

DUNSTABLE, Bedfordshire, England

A. E. Rylander, Esq.,
Technical Editor of *The Tool Engineer*.

Dear Sir:

Further to my letter of the 12th instant, after contacting the Manufacturers, I now have their permission to give you full particulars of the machine in question which is a No. 10 Universal Thread Grinder manufactured under "Matrix" patents by the Coventry Gauge & Tool Co. Ltd. This machine can be considered fully universal for all types of thread grinding although it has now been superseded by improved models. It is in our opinion a very fine precision machine. Particulars are as follows:

1. Swing 8½ inches.
2. Distance between centres 20", and will grind threads this length.
3. Fitted with adjustable form relieving attachment for taps and hobs.
4. The grinding head will swivel for right and left hand helix angles up to 45° each way.
5. Taper attachment.
6. Pitch correction adjustment of .0001" for one turn of 50 graduations.
7. Adaptable for either crusher grinding internal and external, or for truing multi ribs wheel with "Matrix" patented diamond truer both internal and external.
8. Pitches of threads range according to change wheels (gears) available which, in our case, are from 40 threads to the inch down to 4 threads to the inch.
9. Adaptable for collet or chuck work, Right or Left Hand threads.
10. Work head has large range of speeds and live or dead centres.
11. Manned (manual) and automatic wheel throwout.
12. Side cut control.
13. Any spiral lead for taps and hobs according to change wheels available.
14. Practically all types of screw threads can be ground to the finest gauge limits with the possible exception of straight sided square threads, although this is not impossible in some instances.

If there are any further particulars you require please let me know. I regret the delay in answering but this was due to the absence on holiday of the Managing Director of The Coventry Gauge & Tool Company—Mr. S. J. Harley—from whom it was necessary to obtain permission to send you these particulars. He was most helpful in giving all the assistance he could, and he would like to receive a copy of "The Tool Engineer" when this article is published.

Goodbye and good luck to my Colleagues in the States,

Yours truly,

L H Rhodes

We thank Mr. Rhodes, who is an A.S.T.E. member-at-large, for conveying the above information, and, in behalf of his fellow Tool Engineers in the States and Canada, send greetings back to our Colleagues in England.

The Editors

By Philip G. Fishback

Planned Simplified Inspection

Two Fundamental Principles—A Sound Foundation and Inter-Departmental Cooperation—Determine the Efficiency of a Good Inspection Department

INSPECTION is a service linking Management, Engineering and Production, enabling the manufacturer to produce a satisfactory product at a minimum cost. This is arrived at by elimination of errors, that, ultimately, show up in assembly as improper fitting parts requiring slow and costly assembly procedures necessitating expensive skilled mechanics to correct. Such mistakes should have been detected and corrected in the machining of the parts.

Inspection is also a service insuring the customer receiving a product of high quality, efficiently produced and assuring better, smoother operation and greater ease of repair, should this be required. So, we must look upon inspection as the customer's representative whose duty in the plant is to protect the dealer's interest, assuring his receiving a product that will in turn satisfy his customer and be worthy of his recommendation and repeat orders.

Philip G. Fishback **learned tool and gage making, and designing, in a shop operated by his father, and took evening courses in Tool Engineering at the University of Rochester. He joined Graflex, Inc., in 1943, as designer of precision tools, then, early in '43, was assigned to setting up a complete gage control and inspection system. He is 1st Vice Chairman of the Gage Control group of the Society of Quality Control Engineers and a member of Rochester Chapter, A.S.T.E.**

It is the writer's belief that an Inspection Department, to operate efficiently, must recognize that there are *two fundamental principles* that will determine success or failure. These are:

(1) A sound foundation—i.e., a basic prefix of rules governing "*What* to do, and *How* to do it" and, (2) Cooperation. And, just as "a chain is no stronger than its weakest link," so each link in a chain of inspection sequences must be strongly welded. Cooperation is the flux in these links, and the moment any one of these links becomes weakened, real inspection is in danger of disintegration.

In returning to the first requisite, it can be stated that if a *fixed standard of procedure*—a system of "what" and "how" inspection is to be conducted—be established and, once established, strictly adhered to, that this will constitute a sound foundation upon which to build the Inspection Department. In establishing this method of procedure, our first aim should be to make this procedure simple and understandable. *Simplicity* is both desirable and profitable, permitting subsequent planning to follow a normal course.

It is the writer's intention, in these pages, to not only separate operations of inspection into natural component parts, but, based upon personal observations, to suggest simple means of eliminating at least some of the friction and subsequent delays and bottle-necks often encountered. For it is only when these hindrances are removed that production can be improved, enabling the "making of a better product at a lower cost."

Chief Inspector

A Chief Inspector should be in charge of the inspection department. He is held accountable for the acts of his subordinates and his own responsibility should be definitely outlined by Management. The man selected for this post should have the following qualifications:

(a) He should have past practical experience in precision bench work, have a thorough knowledge of layout and be familiar with general machining practice.

(b) He should have the ability to meet in conference with Management, Engineering, Methods and Production and, at such meetings, be capable of rendering assistance in eliminating troublesome factors that interfere with smooth and economic operation.

(c) He must have the ability of creating and maintaining a smooth working organization whose main object is to cooperate and be of real service to all departments contacted. He must recognize that his organization is not a producer, but a service to help production to complete a product within his blue print specifications and, if this is impractical, he should be qualified to recommend a change in specifications.

(d) He must maintain complete unity within his department and not tolerate any "buck-passing" among his group leaders or their subordinates. In a well organized inspection department there should be no place to "pass the buck." There should be no overlapping departments or joint responsibilities, rather, every man's duty and responsibility should be clearly defined.

In short, the man wanted is a man who has the "know how"—capable of using common horse sense—rather than a director of those who have the know how. The fixing of responsibility dictates the need for this type of man. We must remember that in Inspection especially, when every member of the department knows that his superior has the know how, the superior will gain and retain the respect of his subordinates, and as respect fosters willingness of cooperation, that is an important consideration.

Receiving Inspection

To complete our products, we must purchase raw materials as well as finished and semi-finished parts that enter into

FIG. 1.

INSPECTION PROCESS Part No._____

Used on_____ Material_____

Dim. & Tol.	Method	% of Insp.

Remarks

(over)

FIG. 2.

NOTICE

Items shown are for use on a precision product and subject to rigid inspection. All tolerances must be adhered to *as no deviation is permissable.*

their manufacture. While a great many purchased items require only a check to ascertain correct weight or count of parts entering the receiving room, plus a visual inspection for possible damage, improper finish or general discrepancy (usually the fixed responsibility of the receiving clerk) others, both raw material as well as finished and semi-finished parts or assemblies, definitely fall under the responsibility of the inspection department before acceptance into the stock room.

So, first, we must differentiate between what need only be checked by the receiving clerk and what must be subjected to a more rigid inspection by "receiving inspection" and right here, the need of our first principle of the "what and how" of inspection becomes apparent.

A list of items subject to "receiving inspection" should be compiled, and a copy of this list placed in the hands of the respective departments where requisitions for such items naturally originate. A copy of this list should also be placed in the hands of the Purchasing Department so that, by following the procedure hereinafter set forth, both *requisition* as well as *purchase order* will plainly show on the face thereof that items covered therein are subject to receiving inspection.

Colors for Identification

A simple method of identification of such requisitions should be established. As a suggestion, a distinct color requisition blank should be used, differing from that used for items not subject to receiving inspection before clearance into the stock room. Rather than routing such requisitions direct to purchasing, the following should be the procedure:

The *original and one copy* of such requisitions should be routed direct to the Chief Inspector who, upon receiving them, will enter on *both copies* the following information, taken from the "Process Card" shown in Fig. 1: The *type* of gage that will be used by receiving inspection such as "inspection by plug gage, air gage, ring thread, roll thread, as well as unilateral, bilateral or commercial" and, in the event of screws, the class fit required. He should then forward *both copies* to the Purchasing Department.

Purchase orders should show this information on the face thereof in addition to the rubber stamp shown in Fig. 2. One copy of the original requisition, showing the purchase order number, is returned to the inspection department for future reference, as will be shown.

Obviously, we have now given the vendor the necessary information to help him before making shipment. We have minimized the probability of future controversy or delay that might occur because the vendor, on account of improper or incomplete information, has supplied unacceptable merchandise.

In order to follow the foregoing procedure, it becomes evident that a general survey be made of everything entering into the manufacture of the product in order that this list be as complete as possible. Naturally, the list must be corrected and augmented from time to time, to keep it up to date, but the initial list should include castings, die castings, special formed or drawn stock, screws for size and fit as well as special ground stock for drill size and so on.

Once this list of "*what to inspect*" is completed, the Chief Inspector should be called into conference and the procedure of "*how to inspect*" be established. These procedures should then be recorded on the "Process Card," Fig. 1. Thus, a *basic procedure* of inspection is inaugurated.

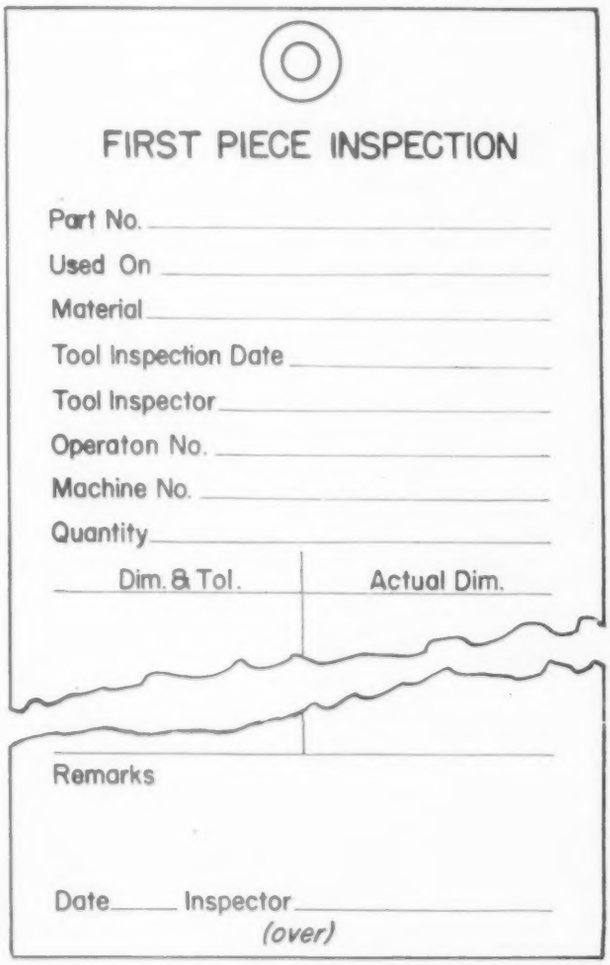
Suitable work bench space, in or near the receiving room, should be provided where receiving inspection is performed. Until such time as sufficient material subject to "receiving inspection" is received to warrant a permanent receiving inspector, the following plan can be adopted:

When a shipment subject to receiving inspection arrives, the receiving clerk contacts the chief inspector, advising him that shipment on "*purchase order Number so and so*" has been received. The chief inspector then refers to his requisition file showing the purchase order number, checks for the inspection procedure on his "Process Card," gives the necessary information and required gages to a parts inspector and details him to perform the inspection.

Where materials subject to analytical or laboratory tests are involved, the same procedure is followed and such items definitely remain the responsibility of "Receiving Inspection" until the confirming report of the material's acceptability is received from the laboratory.

The receiving inspector must render a complete written inspection report to his chief. Where a "sampling plan" is used, the report must show: (a) Condition of parts; (b) percentage inspected; (c) percentage out of tolerance and, (d) specify what is out of tolerance. From this report a decision can be reached whether the shipment is acceptable or not.

FIG. 3.



Where parts or material are not accepted and returned to the vendor, it is the duty of the chief inspector to make an immediate report, in duplicate, of the unacceptability and return of the parts, giving the reason for such return to both the accounting department (direct or via Management) and to the purchasing department, so that the former may withhold invoice payment and the latter notify the vendor of the action taken and the reason therefor.

The foregoing cycle of this method of procedure clearly demonstrates the necessity of close, harmonious cooperation between all departments affected. Here we have definitely linked Inspection with Engineering, Quality Control, Accounting, Purchasing, the foreman of the department where the order or requisition originated, and the receiving clerk. In fact, we have reached out of our own organization to include the vendor.

Adherence to the foregoing procedure will affect the true solution to more efficient operation, raising not only the status of inspection, but of all departments contacted, thereby minimizing subsequent headaches and delays, and providing a genuine help to Production in "making a better product at a lower cost."

Floor Inspection

This should be the main source of inspecting the product being manufactured. The floor inspection unit should work in close harmony with the machine operators but within certain limitations that must be recognized by this branch of the inspection service.

Definitely, there is no room for the "that's good enough" type of inspector in this department. It is NOT up to the inspector to JUDGE whether a part is usable or not when it exceeds blue print specifications—and contrary to the prevalent belief of some inspectors, no inspector should be authorized to shut down any machine, whatever the cause may be. When a part exceeds blue print tolerance, the following should be the procedure:

(1) Notify the operator that the job is out of tolerance and record this fact, on his inspection card, together with a time record of the notification. (2) If the operator continues running the job, the inspector should notify the foreman of the department with this fact, again making a time record of this notification. This procedure eliminates any chance direct argument with the operator.

FIG. 4.

(3) Should the foreman permit the job to proceed, the inspector should notify the Chief Inspector with a written and signed memo of the facts in the case, together with a time record of this notification as well as preceding time recordings as above mentioned. (4) Upon receiving this memo, the Chief Inspector should immediately report this fact, with the accumulated time recordings in writing, to the Production Manager and send carbon copies of his report to the Floor Superintendent and to the Factory Manager and any others concerned.

In order to expedite action, the chief inspector may, under most conditions, make his report verbally in which case he must nevertheless issue the written report as outlined above, opening with: "confirming my phone conversation of (time of day) . . ." It is important that the time recording of each of the foregoing steps be made. If this procedure is followed you will find that repetitions of like instances diminish because the operator will realize that, with facts so obvious and readily available, action follows fast and, most important to him, that any possible alibi he may think of suddenly becomes impossible.

Most particularly so if the inspector sees that the operator has the necessary gages—it will certainly teach him to use them and thereby avoid the headaches so sure to follow if he doesn't. In other words, the foregoing procedure definitely puts the operator "on the spot" and creates greater efficiency on his part in the future.

Floor Inspection should include "First piece inspection" and the inspector assigned to this job should have: (1) A thorough knowledge of layout and (2), legible handwriting. Without the first requisite he is lost, and without the second those who must check and examine his reports (see tag, Fig. 3) may be confused. When a first piece is submitted to the "First Piece Inspector," it should be accompanied by the Tool Inspection Tag shown in Fig. 4., the use of which is further described in "Tool Inspection" so that he will know the condition of the tool used and whether it had been properly inspected and repaired (if necessary) after it was previously used.

The first piece inspection should not be accepted as a criterion for an entire run of that particular part. The Process Card should definitely show just how often any individual part of an extended run should be checked by the First Piece Inspector in addition to the inspection made by the floor inspector so that a continual check on quality is maintained.

Again, only by following the basic procedure of "what and how" to inspect, as shown on the Process Card, will the waste of time inspecting dimensions that were not deemed sufficiently critical to be included in the "method of procedure" be eliminated.

The "Process Card" is the master key to proper inspection. No contrary verbal orders or commitments from the inspector or other members of the organization should be considered valid. All commitments or authorizations should be signed and dated by the person or persons originating them. This will eliminate the "you said this—not that" situation and give a definite and permanent record of the transaction.

Every member of the inspection department must recognize that ultimate quality can only be maintained if print tolerance is maintained—and this brings to mind a condition that, in the writer's belief, deserves some consideration.

Print Tolerance Should be Liberal

Many of us who have been exclusively—or almost so—on inspection work during the past years have come to look upon "deviations" as just one of the natural, necessary evils. Nevertheless, the deviation habit should be cut to a minimum, and, whenever possible, eliminated.

Unusual conditions—as during the recent war production —coupled with red tape, made deviations the logical short ut. It was often impossible, and generally impractical, to ake a change in the blue print. The stuff was needed— the ems were "hot"!—and the cost of production was often of o essence and deviations piled up in front of us and loaded ur files until we felt absolutely frustrated, wondering whether we were just building paper pyramids or trying to produce a product. But that condition no longer exists and our present aim must be concentrated on "making a better product at a lower cost."

So, if a part, out of print tolerance, can be used as well as a part that is within the print tolerance, let's not send through a deviation; rather, let us *change the print tolerance.* By "us", I mean that Inspection, Engineering, Methods—or whoever may be responsible—get together and if the print tolerance can be changed, then let us change it and get it over with. We must remember that the inspector's primary function is to see that print tolerance is maintained. Nevertheless, we must also remember that needless close print tolerance increases the cost of manufacture.

By changing the print tolerance the amount of rejects will be lowered and the deviation paper work will be saved. If only a few parts are rejected on unnecessary close tolerance, but which would pass a *usable* tolerance, these parts would be saved to help decrease the scrap pile rather than help building it up.

On such parts where the Process Card shows the necessity of a special set up in order to follow the method of procedure, a layout detail, as shown in Fig. 5 should be prepared with all necessary formulas and given to both the First Piece and the Parts Inspector. This procedure applies specifically to instances where unusual setups are required because the quantity of parts to be inspected does not warrant the making of a special gage.

With the aid of such a layout detail, the inspector knows how to set up his work and, by substituting his measurements for those given in the formula, obtains his checking dimensions and gives us the answer most desired.

Parts Inspection

In planning the "what" and "how" of parts inspection, the Process Card should not only show what dimensions must be checked and the gage to be used, but special attention should be called to the finish required and any troublesome factors that have been encountered and which require a more critical inspection procedure. All substandard work falls under the responsibility of the Parts Inspector.

While some parts have functions that necessitate a complete individual check for all tolerances, where we have an efficient floor inspection setup, others may be inspected by a "sampling method". In determining the category into which these parts fall, interchangeability, replacement service and actual sustaining operating requirements should be the deciding factor. Wherever possible however, a sampling method should be adopted because it enables us, with only a limited personnel, to do a greater volume of work.

Sequential Analysis Favored

Of the various sampling methods to select, the writer favors a "Sequential Analysis" plan because it enables us to ascertain the condition of an entire lot of parts with a preestablished risk of error. Easily adapted to changing conditions, this plan is based on what we consider a good lot as to percentage of rejects, also, on just how far we wish to go in accepting a "lot" with a higher percentage of rejects.

After determining the tolerance limits and risk of error that we wish to assume, we prepare the inspection graph as shown in Fig. 6, basing our plot on the proportion of risk assumed in accepting a bad lot or rejecting a good lot.

By inspecting parts picked from a "lot" at random, we record our findings in sequence, carrying on a straight course as shown by bottom row of "X" as long as parts are acceptable. Fig. 6 shows both a lot that will be acceptable ("X") and another lot ("O") that will have to be rejected. The first reject encountered is recorded by raising our "X" (or "O" in second lot shown) one square, continuing on this plane for all acceptable parts until we encounter another "reject" which then is recorded by "X" on the next higher square and this course is continued for all acceptable parts until another "reject" again alters our course to the next higher plane.

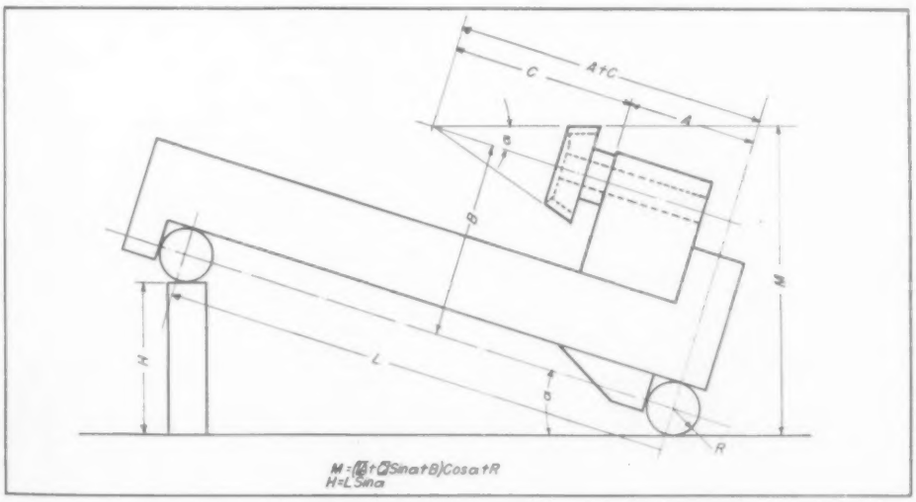
By doing this, it will be noted that the more rejects we encounter, the more parts must be inspected before we reach the "acceptance" (or "rejection" as shown by "O") border, thus causing a proportionate increase in the quantity of parts that must be inspected to compensate for rejected parts.

When we reach the acceptance or "rejection" border, we have a very good graphic representation of the condition of the "lot." This evidence warrants a decision as to whether the entire lot is acceptable or unacceptable, since, in forming a decision, we know the amount of error or risk based upon the quality tolerance limits that have been taken.

If, in our opinion, the recordings of the first graph is insufficient to warrant a decision either way without too great a risk of error, an additional item (or a group of items) is inspected and the decision is reconsidered on the basis of the additional information thus applied. And so, inspection may be continued until the data recorded on the additional graphs is sufficient to warrant a decision on the acceptability or rejection of the lot.

Where the sequential analysis plan (or any other sampling plan) of inspection is to be used, the Process Card should so specify, and the necessary graph and gages given to the parts inspector so that he is in full possession of the information of "what" and "how" of inspection to be performed.

FIG. 5.



Final Inspection

This phase of the inspection service may be likened to the scrutiny that would be given our product by the super critical customer. Therefore, the completed product should be inspected for the following factors: (1) Put the product through a complete functional test if possible; (2) check for the desired characteristics—ease and accuracy of operation; (3) check for proper assembly, such as testing that all screws are tight and that all joints and connections are properly made and, (4) check for appearance, finish, and be sure that all burrs or sharp edges are removed.

The Final Inspector must view the product as the ultimate consumer sees it—plus his "know" about the reliability of operation. We must remember that when the product leaves the final inspector, it is out of our hands and open to public criticism. So, by giving the product an efficient, minute final inspection, we help to minimize this criticism.

A recording check should be made of every reject, together with the *reason* for the rejection; thus, when several completed products are being rejected for the same reason, it is easy to check on the department responsible for the imperfection so that this may be corrected.

Tool Inspection

All new tools should be checked before they are used in the plant. A "Tool Inspection Tag"—such as in Fig. 4—properly filled out by the tool inspector, should be attached to the tool and the perforated end should be kept on file by the inspection department. Every jig or fixture should be checked AFTER a job has been run on which it was used. Entry is made on both sections of the tag and, if there is not sufficient room on the face of the tag, the reverse side thereof should also be used.

At least four successive sections of that half of the tag intended for filing should be saved so that, by having the information entered thereon readily available, any troublesome factors in excessive tool wear will more readily be detected, and the tool corrected to eliminate such a condition. By following the procedure of inspecting the tool after it has been used, if the jig or fixture shows wear it will be detected at that time and the necessary repair made before the tool is returned to the tool crib for storage.

Thus, when the fixture is again needed, tie up in production, due to waiting for the repair to be made at that time, is eliminated. Effecting the repair that may be required after the jig or fixture has been used, rather than depending upon the necessary repair being made before the tool is again needed, will also eliminate the run of faulty parts because the wear was not detected before the tool was again put into use.

Last Part Checked with Tool

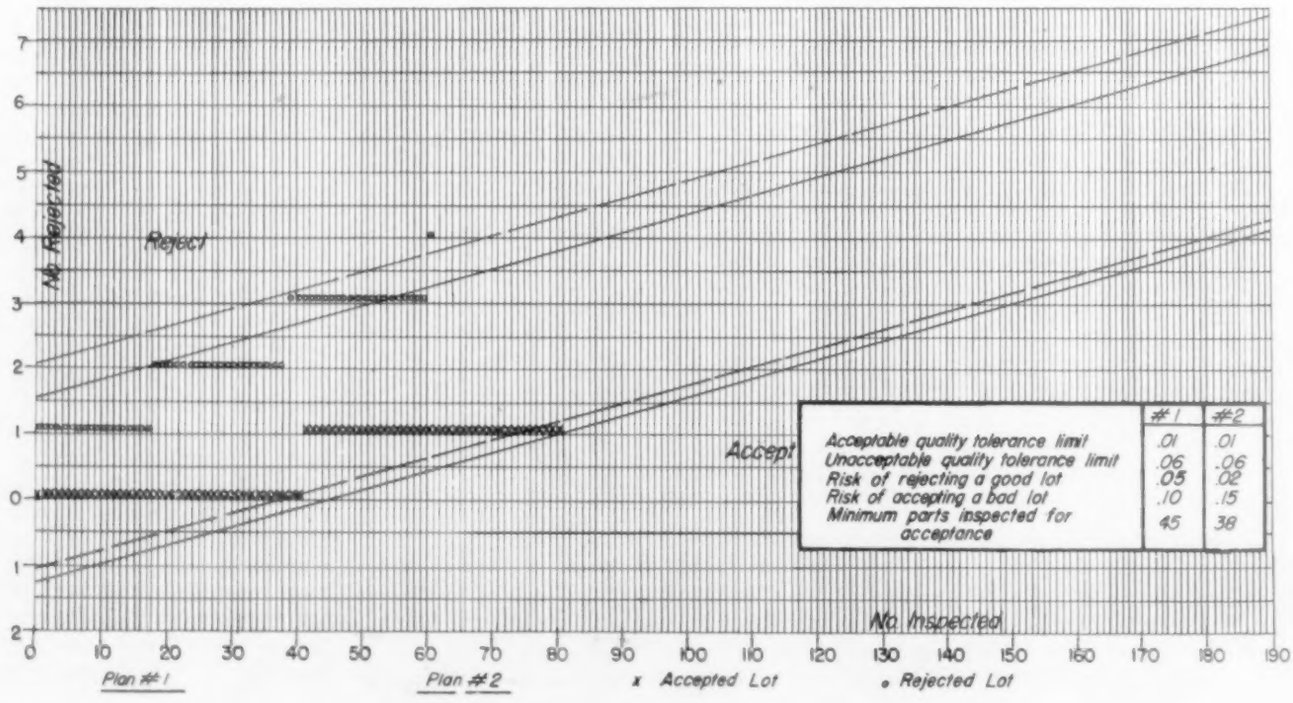
When the jig or fixture, after a run has been completed, is returned for inspection, the last piece made thereon should accompany same and duly noted on the inspection tag so that it may be checked with the tool. The inspection tag should remain on the tool while necessary repairs are being made—in fact, the final inspection tag remaining on the tool and delivered with the tool to the operator when it is again required so that the procedure as outlined in "Floor Inspection" can be completed.

While the foregoing procedure will enable the Chief Inspector to keep a close check on tool conditions, a separate "tool record" should nevertheless be kept of every jig and fixture, showing when and by whom inspected—what repairs, if any, were required and when the necessary repair work was completed. Only after the foregoing procedure has been completed, and all information recorded as required, should the tool or fixture be returned for storage in the tool crib.

Gage Control

Gage control and the efficient administration thereof embodies so many individual problems that it is worthy of a separate descriptive brief. Gage inspection should follow a similar procedure but, as there is an additional burden on gage inspection—that of providing suitable gages for checking work done in the plant as well as by sub-contractors—close cooperation between gage inspection and the Methods Department is essential.

FIG. 6.



By **Edwin H. Halvorsen**

Metal Surfacing by Hard Chromium Plating

Through Improved Methods and New Developments, Chromium Plating is Assuming an Important Place in Tooling Industry

THE ELECTROLYTIC deposit of chromium is, of course, not a new process—in fact, it dates back to 1838, when Junot first deposited chromium on a baser metal. However, Bunsen is given the credit for having first electro-deposited chromium (about 1854) although Geuther was apparently the first (1894) to accomplish this from chromic acid baths, to which were added various other acids, including sulphuric. In 1905, in their work at Cornell University, Carveth and Curry verified, in part, the proposals set forth by Geuther. In that year, also, Placet and Bonnet proved that chromium could be deposited from chromic acid solutions providing that a foreign acid—preferably sulphuric—was present and that a high current density was employed.

Edwin H. Halvorsen **is a graduate of Harvard University, and became interested in chromium plating during years of practice as a consulting engineer. In 1945, after several years devoted to research and development, he organized the Cro-Micron Process & Research Corp'n, of which he was elected president and treasurer. Coincidentally, Lt. James C. Whittaker (co-pilot of the Rickenbacker flight which fell in the Pacific) was elected vice-president and secretary.**

In extensive researches carried out at Cornell University under Dr. Bancroft and Dr. Carveth, a few years later, Sargent determined a considerable number of factors important in chromium plating. These included a satisfactory bath formula made up of chromic acid and chromium sulphate, suitable conditions of concentrations, current density and temperature, the function of lead anodes and the necessity for close regulation.

Following the publication of Sargent's work in 1920, interest in the process rapidly increased and, before 1923, a half dozen or more companies in the United States had development work in progress which soon led to extensive commercial practice. Thus grew the business of decorative chromium plating. And, although plating at this time was not generally applied to articles which were subjected to high pressures or shock, it did become very popular in such fields as furniture, novelties and jewelry.

Decorative Chromium Plating

The first step, in preparing base metal for decorative chromium plating, is to buff it, thereby removing as much of the fragmented surface as possible. This leaves the surface polished and smooth and gives the finished coating an appealing appearance. In some cases, in place of plating chromium directly upon the metal, a coating of copper is deposited and buffed to a high polish, and the chromium is then deposited over the copper plate. This is done because of the receptiveness of copper to the succeeding deposit and also because, having a high conductivity factor, it is easier to plate on copper than on a base metal with a much lower conductivity factor.

In some cases, decorative plating is done by plating with copper, nickel and then chromium—copper for uniform deposit, nickel for reflectivity and chromium for wear. This type of plating is done a little differently than hard chromium plating. For one thing, the temperature of the bath is lower and the current density proportionately lower. This type of bath will have a ratio of chromic acid to sulphuric of 100 to 1 (in this case that would be 53 oz/gal of chromium trioxide to 0.53 oz/gal of sulphuric acid) adding water to complete one gallon—or 128 oz. for a one gallon

We present this article, to our readers, fully aware that claims made for chromium plating, in the past, have at times been premature. Realization has fallen short of expectation. For example, it has not proven entirely satisfactory when applied to cutting tools; as a result, the process does not carry the unqualified endorsement of the cutting tool industry.

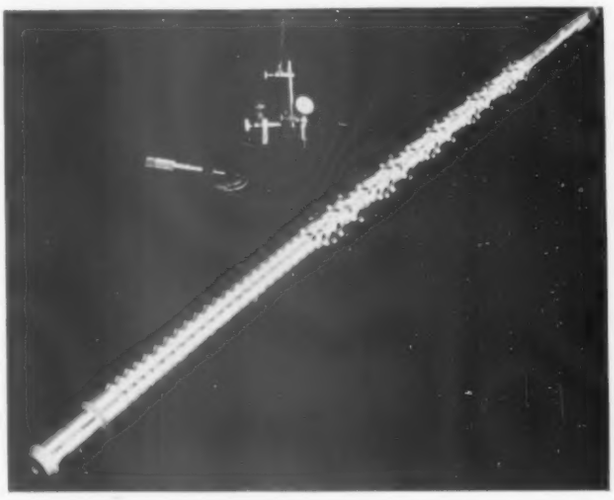
This, however, does not imply a "thumbs down" attitude on the part of manufacturers of cutting tools, the most of whom are receptive to methods that will increase tool efficiency and life. It's just that past experiences have made them cautious; they're "from Missouri"—want to be shown.

As a matter of fact, chromium plating has been successfully applied, for a number of years, to the surfacing of new plug and ring gages, shafts and machine parts. It has also been used to recondition worn or undersized gages and parts, and has won a definite place in the salvaging of expensive tools. Yet, in the modern sense, it is a comparatively new process and, like all new things that eventually "arrive" is undergoing constant development and improvement.

The author of this article, which is a sequel to "Chromium Plating of Cutting Tools," November '45 *The Tool Engineer*, makes no exaggerated claims. Rather, his presentation is conservative and, we believe after considerable investigation, sufficiently within the facts to warrant publication. For, as the process refines and develops—and it will progress the faster for encouragement—it should eventually assume as important a place in the tool industry as it now enjoys in the decorative field.

The Editors

A pull broach having what is known as "roto cut" teeth. A broach of this type is used on steel forgings in which no previous machining operations have been performed. The broach is designed to penetrate through the abrasive scale and to finish to the required diameter. Photo by courtesy Michigan Broach Co.



solution. The bath temperature is 105 degrees F., and the current density, to obtain bright deposits, 115 amperes per square foot.

Hard Chromium Plating

The growth of hard chromium plating is due to the unique combination of properties of the metal deposited, which is not found in other methods of hard surfacing. In addition to being hard, electro-deposited chromium has an especially low coefficient of friction, a high resistance to seizure and, when plated to sufficient thickness, a high resistance to corrosion. The thickness of the deposit will vary, dependent upon the application of the work processed, from less than 0.0001" upwards to 0.010" or even more; however, cutting tools are mostly plated in the thinner range.

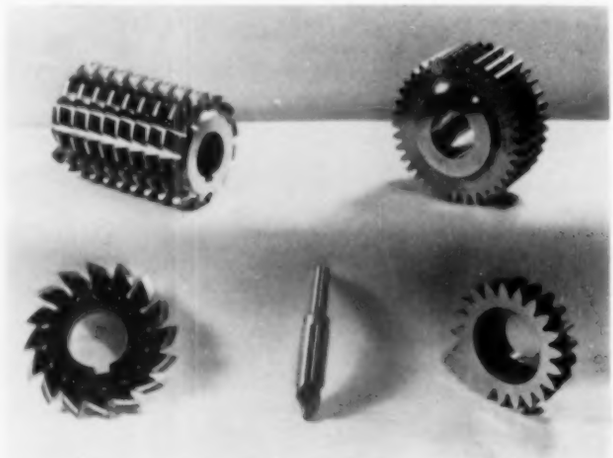
It is difficult to determine the exact hardness value for thin deposits of chromium, but the U. S. Bureau of Standards gives deposited chromium a Brinell value of between 900 and 1200. Consistent Rockwell readings have been gained from 80 and 85 "C" scale. In addition to the characteristics of deposited chromium of being slippery and having a quality of being greasy or self lubricating, some other physical properties are given here:

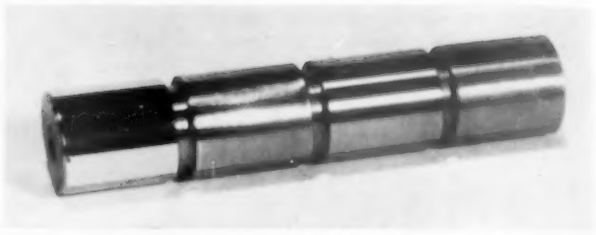
Density (as deposited)	6.93
Density (after annealing)	7.10 to 7.15
Melting point	1920-Deg. C., (3,488 F.)
Electrical resistivity (annealed)	13.1 to 19.3 x 10^6 ohm/cm^3
Reflecting power	60 to 66%
Coefficient of expansion (as deposited)	Negative
Coefficient of friction sliding on chromium	0.12
Coefficient of friction sliding on babbit	0.13
Coefficient of friction sliding on steel	0.16
Coefficient of friction sliding steel on steel	0.30

As explained in the previous article on this subject, the reason hard chromium plating (as applied to the surfacing of high speed cutting tools or other cutting tools which are subjected to shock or high pressures) has not advanced until recent years is that the deposited metal was quite brittle. This was caused by caged hydrogen within the metal which, when subjected to any appreciable pressure, would immediately expand and, in its effort to free itself, would break the chromium metal which housed it. This is known as peeling, spalling or chipping.

However, with the development of a heat treating process which relieves the hydrogen and allows it to slowly ooze out, leaving the plated surface free of any embrittlement, it becomes a first in metal surfacing. Before going further with hard surfacing by chromium plating, however, let us stop and examine other types of surfacing and other alloys in use today. By so doing we can better understand and evaluate the over-all picture.

The group shown here illustrates excellent finish and workmanship. All tools are from 18-4-1 High Speed Steel, except the hob, which was used for cutting an hour-glass worm—an aircraft part—and which is of Moly type High Speed Steel. Photo by courtesy of National Tool Co.





This sample bar illustrates four types of finishes, namely (from right to left), turned, commercially ground, 30 seconds Superfinish and Super finish. This test bar provides a clear picture of the comparative values of various finishes. Photo by courtesy Chrysler Corporation.

Cemented Tungsten Carbide

The development of cemented—or sintered—tungsten carbides, for use in wire drawing dies, was of American origin; however, its use as a tool material was developed in Germany during World War I. Later (around 1922) experiments with this material as a cutting tool proved so successful that, by 1928, tungsten carbide tools began to have an important place in industry. Tungsten carbide, as the reader doubtless knows, is made by compressing powders of tungsten, carbon, and cobalt to the desired shapes.

These blocks are then sintered at a high temperature in a reducing inert atmosphere and, after this treatment, the material cannot be cast, forged or in any way heat treated. Due to the cost of tungsten carbide, only small pieces are used for tools in commercial machining operations, the tips being welded or brazed into a high carbon steel tool shank by using copper, bronze or silver as a brazing element with borax ordinarily used as a flux.

Tungsten carbide tools are limited, in application, in several ways. This, of course, does not mean that the tools are not good; it simply means that the smart engineer will be cognizant of their limitations and will not try to force them to uses for which they are not suited. Tungsten carbide tools have little elasticity, are brittle and have considerably less resistance to bending than high speed steel. They cannot be subjected to much vibration or chatter, therefore, to successfully handle the increased cutting speeds the tools permit, heavy rigid machines are required.

Due to the hardness of tungsten carbide, sharpening must be done with a special diamond wheel, or with a special bonded abrasive. The cutting edge should be finished to the highest possible degree, and great care must be exercised in sharpening. The grinding is so important that some manufacturers of carbide tools operate free schools for the shop men, giving them a practical course in the use, application and maintenance of this type of tool.

Stellite

Stellite, a non-ferrous alloy, was developed about 1915. For some work, it was found to be superior to a high speed steel tool, particularly for light continuous cuts for either steel or cast iron. It is a cast material, very hard and brittle and very resistant to abrasion. Stellite tools are tougher and cut better when cold than when hot, however, they would not be affected by heat of 1500 degrees F.

Special grades of Stellite have been subsequently marketed under the trade names of J-Metal and M2-98, the former advocated for finish cuts and the latter for rough cuts. The M2-98 is very hard and it is necessary to use a diamond wheel when sharpening the tool. Both of these alloys have proven successful in cutting material at considerably higher speeds than was possible with the original Stellite.

This special high speed steel reamer well illustrates the value of super finish. Chip relief is easier than on similar tools where the surface has not been given a finish treatment, and are therefore more economical to use. Photo by courtesy W. L. Brubaker & Bros.

Tantalum and Titanium Carbide Tools

While the cemented tungsten carbides are particularly adapted for machining cast iron and non-ferrous types of material, steel parts appear to machine better with cemented carbide tools having tantalum and/or titanium added. This is because these elements impart an "oiliness" to tungsten carbide which enables the chip to slide over the tool face more easily. All of these finer grained tool materials are available in hardness up to 78 Rockwell "C," as against a hardness of only 66 Rockwell "C" which may be considered the practical limit for high speed steel.

Chromium Plated High Speed Steel Tools

The direct electrode deposition of chromium, on a high speed steel base, results in the combination of all the excellent features of the foregoing types of tools, plus the elimination of the undesirable features. The plated tool will have extreme hardness in excess of some of the aforementioned tools. Deposited chromium, upon a steel base, will have a hardness up to 85 on the Rockwell "C" scale, and will withstand heat up to 1700 degrees F. before any notable change occurs. (Cemented carbides, operating at speeds of 200 to 500 sfm, withstand a temperature of 2000 degrees F. before tool failure occurs.)

Chromium plated steel tools also have the quality of oiliness, a quality that allows easy and fast chip relief. Added to this, fine chip particles cannot weld on the cutting edges of the tool. By a special heat treatment—a rather recent development—of the plated tool, the tool plating is rendered completely free of embrittlement. Most important of all, to the tool engineer, is that *deposited chromium has a lower coefficient of friction than any other metal now known.*

Surface Finish Important

The preparation of metal surfaces, prior to deposit of hard chromium, is quite simple for all practical purposes. Essentially, it consists of properly cleaning the surface to render it completely free from any foreign particles embedded in the pores of the metal surface, and to rid it of grease, oil or wax. This is very important since chromium will not properly adhere to a dirty surface.

In this connection, we can point out that the degree of finish, put on the tool by the maker, has a considerable bearing on chrome plating. And even without chrome plating, the reduction of the fragmented surface to a minimum will aid in decreasing friction and will increase the life of the tool or part considerably. Superfinish, to use that widely accepted term, pays dividends, not only in increased production but in increased tool life.

However, to merely tell of the good points of good surface finish and of hard chromium plating is hardly the "proof of the pudding." What the reader is interested in is comparative results and these may be had only through actual cut and try. The following presents the case for both plating and finish.

Tests on Gear Shaper Cutters

The results of tests on gear shaper cutters, as shown in Tables I and II, indicate a very great increase in tool life for molybdenum high speed steel cutters used in tests conducted on Fellows gear shapers. In the test, two new gear cutters were used, one being plated with chromium to a thickness less than 0.0001 inch, and the other unplated. Cutters were identical, having specifications as follows:

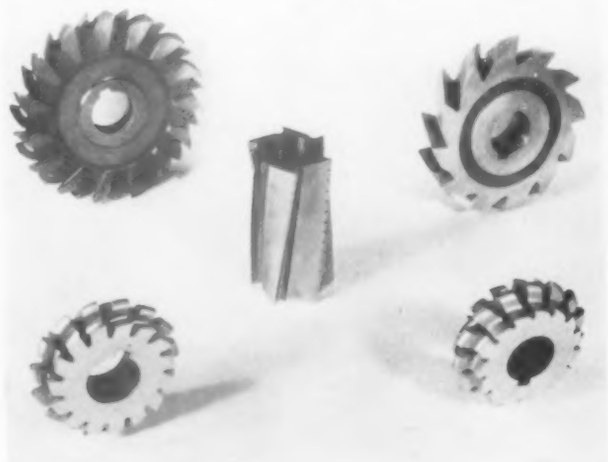
Dimensional pitch	8-10
Pressure angle	20 deg.
No. of teeth	32
Tooth depth	0.225"
Base diameter	3.7551"
Type of cutter	Finishing
Cutter material	8% molybdenum steel
All (workpiece) steel used in test	NE 8447
Brinell hardness between	196 and 200

The chromium plated gear cutter was mounted on a Fellows Type 6-A Gear Shaper and the machine speed was set at 184 strokes per minute, with 1080 strokes per revolution of the cutter, and held constant throughout the test. The gear made two revolutions to remove 0.040" to 0.045" of stock over pins. This cutter finished fifteen gears of 48 teeth each, full width 1¼". The teeth on the first few gears appeared slightly rough, but became smoother as more gears were finished. All gears showed up satisfactorily on a Red-Liner chart.

The unplated cutter was then placed on the same shaper and completed the same test. Then, the plated cutter was remounted in the gear shaper to finish fifteen gears of 52 teeth each with 1¼" face width. The teeth were smooth and the gears checked well within the allowed limits on the Red Liner. The cutter was removed and found to be in good condition with the plating well intact. The cutter by this time had cut 1500 teeth.

The unplated cutter was then remounted in the gear shaper and was started cutting the same type gears as was completed by the plated cutter. The 20th gear finished—or the fifth gear in the second run—showed greater errors than allowed when checked against the master gear on the Red Liner. The cutter was removed and examination showed that one tooth had peeled back. The tool had cut a total of 1760 teeth, 1¼" face, before failure.

A group of War Surplus Material milling cutters as they appear after hard chromium surfacing. The cutter at upper left is made of Rex AA steel and had no finish in its original state. The cutters in upper right and center are made from 6-6-2 type Molybdenum High Speed Steel and both were given a partial finish. The two lower relieved form cutters, made by Gorham Tool Company, are from 8-4-1 (T-1-B) and both had a high degree of finish before hard chromium surfacing. Each group has its own "characteristic" after plating.



The plated cutter was again mounted on the shaper and was used to cut 22 gears of 70 teeth each. Upon examination, after this run, it was discovered that the plating had worn off the cutting edge of the tool, but the cutter was still sharp enough to use further as the base metal of the cutter had not peeled. All gears cut were within the limits of tolerance allowed. At this point, the plated tool had cut a total of 3040 teeth of 1¼" width and was not too dull for continued service.

TABLE I—PERFORMANCE OF PLATED AND UNPLATED GEAR SHAPER CUTTERS

Cutter No.	*Condition*	*Material Cut*	*Number of teeth cut equal to 1¼" wide*	*Ratio of performance*	*Tool After Experiment*
1	Plated	NE 8447	5056	2.88	Red Liner bad, tool not peeled but needed regrinding.
2	Unplated	NE 8447	1760	1	Peeled.
2	Plated	NE 8447	5740	2.67	Red Liner good, tool could continue to cut.
1	Unplated	NE 8447	2150	1	Peeled.

TABLE I. Results of tests indicate a very great increcse in tool life for Molybdenum high speed steel external grinding centers and Molybdenum high speed steel cutters used on Fellows gear shapers.

The cutter was again mounted and used to cut 18 gears of 80 teeth each, with a tooth width of 1¾". (The 1¾" width of face on these gears was equivalent to 112 teeth of the 1¼" width). The gears were finished with two cuts of the finishing cutter at a shaper speed of 184 strokes per minute, with 1280 strokes per revolution of the cutter. The gears checked satisfactorily on the Red Liner* tester. Some of the teeth appeared rough, but were good enough to pass inspection. Upon removal, the cutter was found to be slightly dull.

Tabulating the results of the test (Table II), the plated cutter had cut the equivalent of 5056 teeth with a face width of 1¼", while the unplated cutter had only cut 1760 teeth of the same face width. Both tools were then reground. The amount of metal ground off each cutter is shown in Table I.

Same Cutters Reversed

Later, to insure an absolutely fair test, the unplated cutter was plated and the plated cutter was stripped of its plating, and another series of tests were made. These cutters were used to finish cut 50 gears with 80 teeth, 1¼" face, and 50 gears with 69 teeth, 1½" face. Steel used in these tests was NE 8447, having a Brinell hardness of 202 to 215. The same machine was used as in the previous test and the speeds employed were 184 cutter strokes per minute, with 1080 strokes per revolution of the cutter. (Standard strokes for this machine call for 1260 strokes per minute.) The gears made two revolutions to remove 0.050" to 0.080" of stock over pins.

The plated cutter (which in the first test was the unplated cutter) was mounted and finished cutting 50 of the 80-tooth gears and 21 of the 69-tooth gears without the Red Liner showing any rough teeth. At this point, the plated cutter had cut 4000 1¼" teeth and 1449 1½" teeth. This was equal to 5740 teeth of 1¼" face width. At this point, the plated cutter was removed and found to be slightly dull.

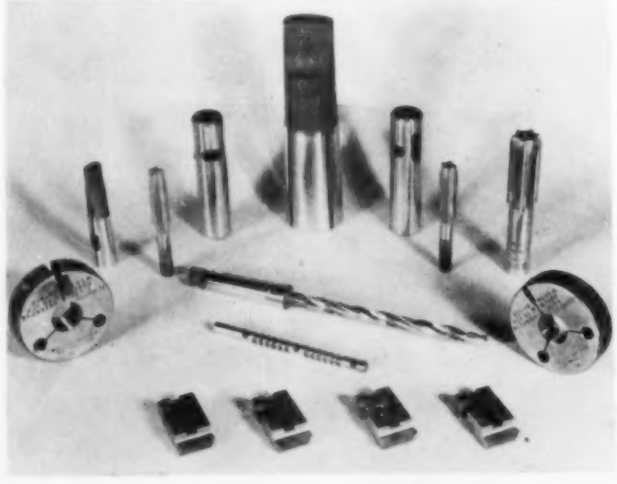
The unplated cutter (the one from which the plating had been stripped) was mounted on the machine and used until the Red Liner chart showed the teeth to be rough. The job was to finish the remaining 69-tooth gears, of which there were 29. For the first 23, the test showed a smooth line, but the 24th gear indicated roughness. However, the gear passed inspection. The chart on the 26th gear was very rough and beyond the limits of allowable error. The unplated cutter had cut 1794 teeth of 1½" width, equivalent to 2150 teeth of 1¼" width. Upon examining this cutter, it was found that one tooth had peeled back slightly. Both tools were sent to grinding for sharpening. The relative performance of the two gear cutters, both plated and unplated, is correlated in Table II.

A testing laboratory, which does considerable testing and research of new materials and processes, ran experiments on three commercial tool bits. The tests were made on both types of bits under as nearly similar conditions as was possible. So that time of test could be held at a minimum, no coolant was used. Furthermore, cutting speed was progressively increased until the cutting edge failed.

Two tests were made with each type tool bit. The unplated commercial tool bit "A" that was used in the first test chipped at the start of the cut. This tool was sharpened

**Red Liner Gear Testing Equipment, by The Fellows Gear Shaper Company.*

Miscellaneous group of War Surplus tools which have undergone hard usage. All are shown chromium surfaced without any preparation except cleaning. None of the tools had been previously buffed or polished, and each is a credit to its manufacturer.



Tools shown against a standard six inch pocket rule to indicate their miniature size. The four on the right are 1/4"-28 thread chasers, and the small tool on the left is a Swiss cutter used by the Bulova Watch Company to cut pinions for the escape wheel on a 10 ligne strap watch. Tolerance is held to 0.00001". Cutters to be chromium surfaced were checked by comparator (50 magnification) before and after plating. The chromium surfacing did not effect the close tolerance in any way. A Cro-Micron Process & Research Corp'n photo.

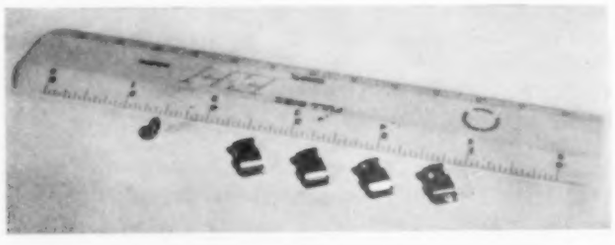


Table II—METAL GROUND OFF IN SHARPENING GEAR SHAPER CUTTERS						
Cutter	*Cutter width before grind*	*Cutter width after grind*	*Metal removed by grind*	*No. of teeth equiv. to 1¼ tooth width*	*Teeth per .001" gr.*	*Ratio of performance*
Unplated	0.8555"	0.7605"	0.095"	1760	18.53	1
Plated	0.9035"	0.8940"	0.0095"	5056	532.22	28 to 1

and used again. In the second test the unplated commercial tool bit "A" also chipped at the end of one length of cut. This bit was set aside and a new one used in the next test.

Before certain cuts were made, the test piece was heated to about 125 degrees F. to keep the temperature of the steel about the same for both tool bits while cutting. Steel rounds were used in the test, but each test employed a steel of a different hardness. Table III shows the results of tests made with forming tools plated against unplated.

Tests were also run using plain carbon steel twist drills, plated, and the results correlated in chart Table IV. It appears that, in some instances, chromium plated plain carbon steel tools can replace (or be a substitute for) high speed tools.

It is most apparent, from information gathered through these tests, that metal surfacing by hard chromium plating reduces the chip friction together with a reduction of spindle torque. The plated tools are cutting with less horsepower than standard high speed steel tools. This is indicated by the different nature of the chips and improved finish cut.

The results of the tests recorded here indicate that metal surfacing by hard chromium plating not only increases the life of cutting tools, but also permits faster machining operations and heavier feeds.

The chromium surfacing increases the hardness of the tool bearing surfaces, the inherent "oiliness" of the deposited chrome prevents galling and building up of cuttings or drillings, and the low coefficient of friction of chromium reduces heating of the tool, with its consequent annealing effect on the tool while in operation. It has been found that even though the plating has been worn through in a tool, the remaining life of the tool is often higher than one which has not been plated. This is probably accounted for by the plating process having a chromizing action as well as a plating action on the tool.

In addition to the advantages brought out here in these various tests on cutting tools, there is also the value in the chromium surfacing of such items as pneumatic drills, and hammers, and pumps and liners, deep well drills, forming dies, and so on ad infinitum through the gamut of tools and machine parts.

Recently, a New Jersey manufacturer submitted some drawing dies, used for forming stainless steel, with the report that they had to be refinished after runs of 50 to 100 pieces. After these dies were plated as received, the manufacturer reported that he was able to get 9,000 pieces before the dies had to be refinished. Examination, at that point, showed the chromium to be worn, but the underlying surface was but slightly damaged. They were stripped of the old remaining chromium, replated and put back into service.

Before plating, the dies had a hardness of 48 Rockwell "C." No check was taken after plating, since it is difficult to get an accurate reading, on chromium plating, with the average Rockwell machine where the kilogram load is so heavy (150). However, a fairly accurate reading can be had with the Knoop Indenter, but even this is a bit too heavy a load for measuring thin chromium surfaces. It may be an interesting note, in this connection, that drawing dies hardened to 64-65 Rockwell "C" do not do as well, after chromium plating, as they do when the original hardness, before plating, is from 48 to 57 Rockwell "C."

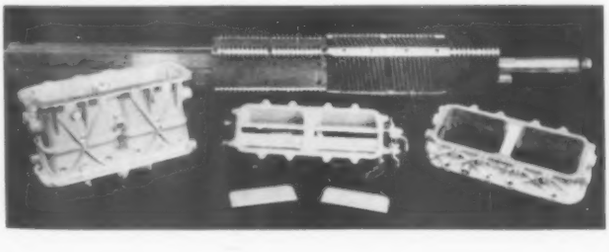
Misconceptions of Chromium Surfacing

Because many engineers are not familiar with chromium surfacing, they labor under misconceptions as to what it can or cannot accomplish. For one thing, it will not make rough surfaces into superfinished surfaces. Chromium deposited upon a surface will only reproduce that which it has to begin with. One cannot expect to send out inferior tools to be plated and expect that, when plated, they will be equivalent to a high grade tool. The poor tool will probably show an increase in life, but will never give results equal to the surfacing of a good tool.

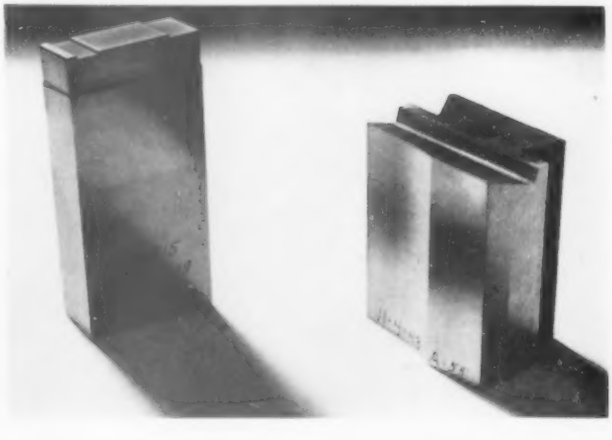
Quite often, manufacturers express a desire to have samples processed so that they may conduct tests in their own plants. Sometimes reports come back that their own unplated tools showed up better than the plated ones. Investigation of many of these cases, however, has disclosed: (1) that the tools were improperly ground; (2) a lack of knowledge of operation, and (3) inexperience in conducting comparative performance test.

For example, a manufacturer will send in a number of twist drills to be processed, and will then conduct very careful tests. In doing so, however, he may have failed to conduct a test for uniform performance of a comparable number of unplated drills, and therefore does not have concrete data upon which to correlate final results. As a

A compound broach—about 4" x 6"—used to finish the holes in a carburetor housing. This type of broach represents considerable engineering and is well worth chromium surfacing, thereby providing easier chip relief with reduced clogging, and increased working life. Photo by courtesy Michigan Broach Co.



Two form cutters, both used to work copper. The alloy composition of these tools is not known. The cutter on the right is used to form 50 cal. machine gun bullet. Plated, the increase in working life, against unplated, is seven times.



matter of fact, unplated twist drills do not perform uniformly, although the differences have never been so great that the user could rightly complain to the supplier.

But, in making exacting tests of plated drills, he discovers the inconsistencies and, taking the path of least mental resistance, immediately blames the chromium plating. This condition is not at all confined to twist drills, which have merely been used as an easier example since they will not entail details to fully clarify the case. Nearly all reliable twist drills, when plated, show an increase in tool life up to 2,000 per cent.

That this thought and experience may not be one sided, the writer discussed this matter with several representative cutting tool manufacturers. They, too, have experienced difficulty with the shops using their tools, in that production personnel lacks the knowledge of proper usage of tools. As with the self taught golfer, who has developed his own way of playing, the results are far from satisfactory. In this connection, it can be said that reputable cutting tool manufacturers—and they are in the majority—take full advantage of good surface finishing and do everything possible to produce tools that compare with the best used in modern production.

Tests, on chromium plated barrels of machine guns, and on chromium plated bullets, during the late war, indicated a considerably increased muzzle velocity, greater accuracy and longer barrel life as compared to unplated. For peacetime application of this plating procedure, we can look to the sportsman and his pet rifle or side arms. By chromium plating the inside of the barrel, he saves the time and worry of cleaning and preserving it before he puts it up or makes ready for his next sporting event.

The inside of plated barrels do not have to be cleaned, and under the protection of hard chromium they will give long, accurate use. After the chromium has become thin, the barrel can be stripped of the old chromium surface and refinished. The gun barrel is then as good as the day it was purchased.

In conclusion, the writer has tried to bring to the attention of those interested in engineering advancement, the great possibilities of hard chromium surfacing, both in everyday shop work, and in the important job of meeting production schedules. Until such time as new metals or processes are discovered, chromium surfaced tools and machine parts will, in the writer's belief, continue to lead the field.

TABLE III—PERFORMANCE DATA ON FORMING TOOLS

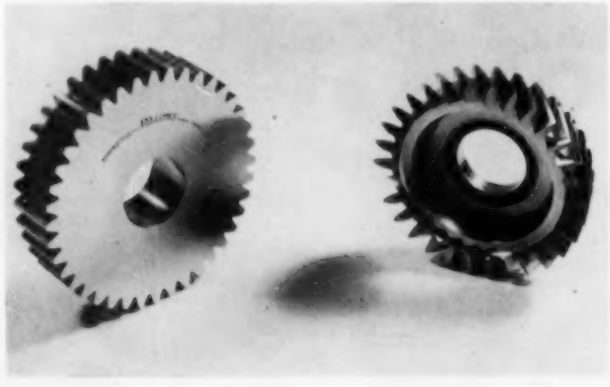
Tool No.	*Type of Tool*	*Brand*	*Condition*	*No. of Cuts*
1	Grooving form tool		Unplated	675
			Plated	1020
			Plated and reground without removing plating	1065
2	Grooving form tool	Trojan	Unplated	400
			Plated	1220
			Plated and reground without removing plating	985
3	Rib form tool	Rex AA	Unplated	230
			Plated	925
			Plated and reground without removing plating	400
4	Rib form tool	Trojan	Unplated	17
			Plated	312
			Plated and reground without removing plating	221
5	Grooving form tool	Spartan	Unplated	77
			Plated	312
			Plated and reground without removing plating	221

TABLE IV—PERFORMANCE OF PLATED AND UNPLATED ½" CARBON TWIST DRILLS

		Number of cuts made after			
Condition	*Plated as received*	*1st Gr.*	*2nd Gr.*	*3rd Gr.*	*Total No. of cuts*
Plated*	163	156	166	159	644
Unplated	48	120	37	42	247

TABLE IV. *The plated drills were found to hold holes to production tolerances thus eliminating the regular subsequent operation of reaming to exact size. Reaming is sometimes necessary when high speed steel drills are used.

This master gear and helical gear cutter illustrate a type of tool where high degree of surface finish has been found to be of great importance. The surfacing of such tool by hard chromium adds considerable to their accuracy and durability. Photo by courtesy Fellows Gear Shaper Company.



A 4-spline pull broach used in the manufacture of poppet valves for Garrand rifles. Photo courtesy Michigan Broach Company.

Two excellently finished serration broaches, each indicating good tooling and interest in giving the user the full benefit of good tool finishes. Photo by courtesy Detroit Broach Co.

By John E. Hyler

Milling Attachments and Accessories

Standard Commercial Appliances Widen Range and Versatility of Horizontal and Vertical Millers

1st of Two Parts

Mr. Hyler

VARIOUS FACTORS COMBINE to affect a judicious decision as to the exact kind of milling equipment that will be used in any given shop. This is equally true with regard to milling machines, and much might be said concerning a decision between various types of millers.

What we have particularly in mind, however, are the problems of adapting a type of equipment, already on the floor, to make it more versatile and more productive for additional kinds of work. We are thinking of milling problems as they are met with in shops varying from the smallest to largest, and of auxiliary equipment that has been designed and produced to meet these various milling needs.

In certain cases and for various reasons, units that are not primarily milling machines have been advantageously converted for light milling duty. This phase of the subject relates more particularly to lathes than to any other machine. The milling cutter, of whatever type, is often held in, and rotated by the lathe spindle, while the attachment is so designed as to hold the work and traverse it past the cutter.

One milling attachment is supplied for use with a certain precision bench lathe, that may be clamped solidly on the lathe bed, in any desired position. It is equipped with three slides. Two of these slides have their action in horizontal planes, and one moves in a direction straight across, or 90 degrees from the other. The third slide is vertical, and to it is attached the work-holding collet, equipped with a 48-notch index plate and pawl. Three different milling or saw arbors are available, to receive cutters with $\frac{1}{4}$", $\frac{3}{8}$", or $\frac{1}{2}$" holes.

Some fixtures, designed for converting a lathe into a milling machine, have been developed so as to make them usable on any standard bench lathe. These have a base that clamps into the toolpost slot on the bench lathe carriage. The fixture is provided with a slide, which may be arranged in vertical position, or which may be tilted to any consistent degree of departure from vertical. One feature is that the portion of the attachment that has vertical (or oblique when tilted) sliding action is primarily fitted with a vise.

This vise can be employed for holding different types of work that require no revolving or indexing, and for carrying them through the cut, the cutter being held in the lathe spindle, as usual. There is an auxiliary collet housing, however, equipped with a notched indexing plate, which is designed for convenient holding in this vise.

This composite arrangement makes the device adaptable for milling indexed cuts in such round work as can be retained in the collet, or milling straight cuts in a variety of work. The tilting arrangement allows making even-depth cuts in conical surfaces. The device has been used to considerable advantage for milling punches, keyways, end mills, and other cutting tools.

FIG. 1. This special fixture, by means of which the connecting rods in process are held, is used where it is important to maintain rather close limits on the width of cut obtained. Use of two interlocking helical cutters allows sufficient spacing adjustment for such maintenance. Since considerable stock is removed, the chip pan provides for easier handling of chips. Photograph courtesy Brown & Sharpe Mfg. Co., Providence 1, R. I.

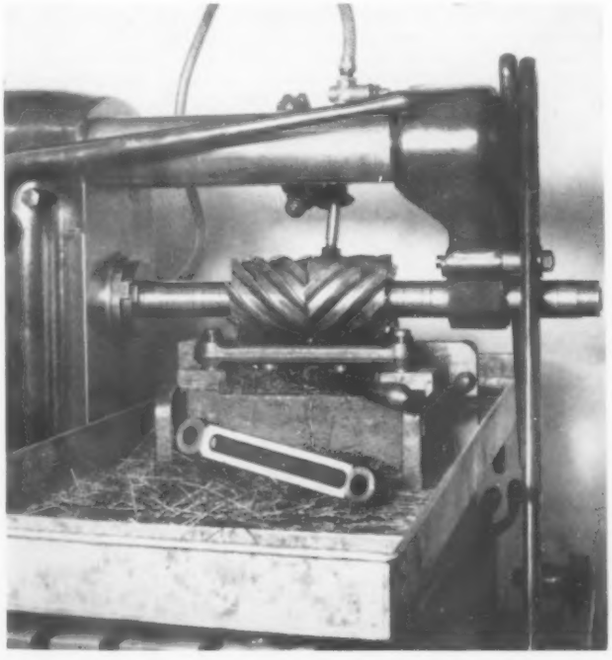
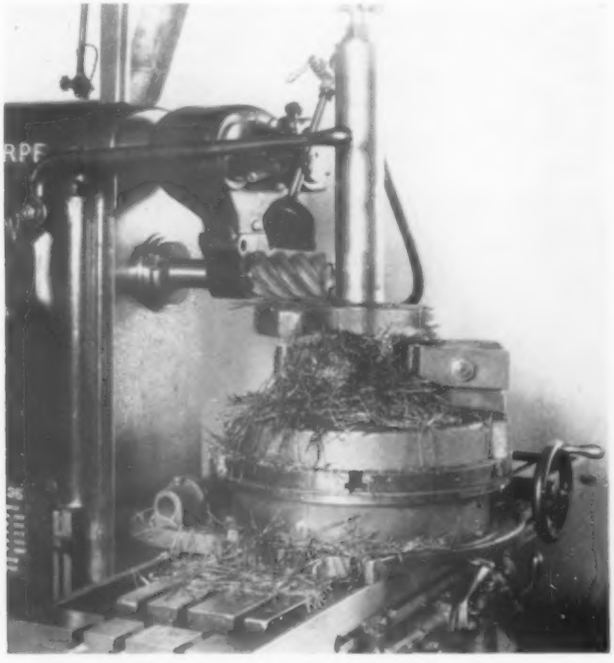


FIG. 2. Rotary milling operation on the back face of a chrome nickel steel airplane crankshaft. Note that the 3" diameter spiral milling cutter is supported on a special arbor of short type, thus providing clearance for elevated end of crankshaft. The crankshaft, itself, is mounted in a fixture, which in turn is mounted on a rotary milling attachment. Photograph of machine is by courtesy Brown & Sharpe Mfg. Co., Providence 1, R. I.



There are some auxiliary millers, designed for application to the lathe, which are adapted to handle heavier work than those already mentioned. These use the lathe headstock as the source of power, but the drive is indirect, the cutter held on a horizontal spindle, and that spindle being adjustable for height. This is really a rigid and high-class outfit. Once it has been installed on the lathe, the method of its operation is identical with that of a plain horizontal miller.

Dividing heads and milling vises can be applied as desired; incidentally, the device increases the swing of the lathe to which it is applied by around 50%, making it very convenient for handling work having a larger swing. While this miller is not made by a lathe manufacturer, some manufacturers of lathes recommend, and job it.

Drill Press as Vertical Miller

In some cases, the drill press has been converted for doing light jobs of vertical milling, the end mill being held in the drill spindle and the work retained on a special milling table. This milling table bolts to the top of the drill press table, and is itself provided with T-slots, for attaching work to its upper surface.

The milling table is arranged with a compound sliding base, there being two slides, one of which has its action 90 degrees removed from that of the other, and each being traversable by ball crank. This milling table, in addition, is rotatably adjustable, and incorporates a graduated circular scale for readily determining the angular value through which it is turned.

Another proposition, with regard to heavy thread milling, concerns a special thread milling attachment. This device can be attached to the bed of a milling machine, or to that of a lathe or precision grinder. This thread miller is so designed that it holds the work, and revolves it on its own axis, at the same time advancing the workpiece axially, at any pre-determined rate. Work may be held in a collet, in a chuck, or on a faceplate as is most convenient.

The work is advanced axially at the determined correct rate by setting a simple graduated index scale at the base of the unit. There is also an easily-made adjustment that allows an operator to rotate the work without advancing it, when this is necessary. Using such an attachment, the machine carrying the milling tool simply provides a rotating cutting tool, and has no other function. Any type of precision thread-cutting job can be set up and milled by an operator with only a moderate amount of experience.

Though all equipment mentioned, to this point, has an indexing aspect of some kind, there is other indexing equipment which is particularly applicable to the regular horizontal miller. Index centers—or heads—are sufficiently well known so that little description is needed here. It may be noted, however, that they are available in a number of types. Direct indexing centers have their uses and, in some cases where a single pair of centers is involved, are actuated by a handwheel.

Triple indexing centers accommodate three pieces of work in parallel, so that all can be milled and all indexed at once, and some of these are actuated through a lever-operated ratchet. Plain index centers incorporating a worm for indexing, are used in both standard and larger sizes. The larger ones provide greater swing for the work, and therefore are adapted for such jobs of gear cutting as come to the miller where the gears are of too great diameter to handle on ordinary index centers. Some of these larger centers handle spur gears up to 16 inches in diameter at the horizontal miller. Triple index centers of the worm, and worm gear type are also in use in some places.

High Ratios Impose Strains

There is not space in this article to go into systems used by manufacturers of the best dividing heads, in the design of these heads, though it is an engaging subject. As for the method of using universal spiral index centers, both for indexing and milling spirals, that is fairly well known, and will not be considered here. It should be noted, however, where it is necessary to mill spirals with very short leads, a higher gearing ratio becomes necessary, imposing a much greater strain on the gears and mechanism.

In order to overcome this, special attachments are provided by certain milling machine manufacturers. One of these, known as a short lead and feed reducing attachment, allows as much as a 20 to 1 reduction, so that leads only 1/20 of normal may be obtained, if desired. The same mechanism is used without the spiral index centers for obtaining extremely fine table feeds when working with a fly cutter, or when, for any other reason, a very fine

FIG. 3. This boring application, on the horizontal miller, involves use of a special adapter plate bolted to the milling machine table, allowing for quick and easy clamping of the cast iron dividing head frames being processed. Cutters used are of staggered tooth type, with cutting edges on one side only. Cut is made by using the cross feed, the table moving outward toward the operator while the work is in the cut. Photograph courtesy Kearney & Trecker Corporation, Milwaukee, Wisconsin.

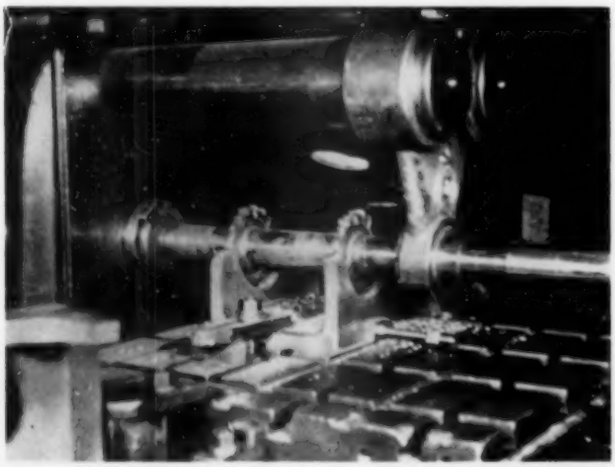
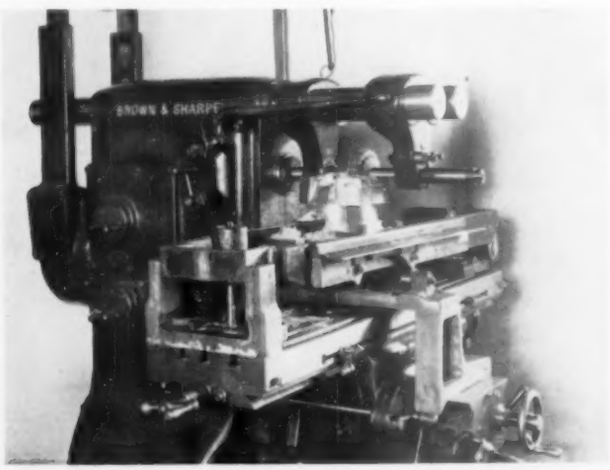


FIG. 4. Gang-milling top fins of airplane duralumin cylinder head on horizontal miller. Six cutters are mounted on arbor, with two arbor yokes used to provide additional rigidity. Cut begins on far side of workpiece, travels up far side on an angle, then across top, and down on near side. To obtain this movement, the work is mounted on an auxiliary tilting table, and to the table is mounted a form which runs over a rigidly-fixed roller. This can be seen at right center of photo. A similar form and roller are used at back edge of table. The tilting table is trunnioned at the far end. Photograph courtesy Brown & Sharpe Mfg. Co., Providence 1, R. I.



feed is desirable. Another company provides a combined long and short lead attachment for one of their millers, which actually has an infinite lead range.

So-called rack-indexing attachments are not indexing equipment in the ordinary sense of the term, but attachments incorporating change gears, which allow the milling machine table to be moved in increments of high accuracy, corresponding exactly to the pitch of racks being milled. Movement of the table, increment by increment, is accomplished by turning a hand crank.

In some cases, the crank is turned a half-revolution, there being two locking notches in the locking disk of the device. In other rack-indexing attachments, one or more full turns of the crank is necessary in all cases, to advance the machine table one step. In that case, only one notch is provided in the locking disc. Although made by different manufacturers, the working principle is identical.

As for chucking and indexing fixtures used with the milling machine, these are usually provided with two different bolting bases, exactly 90 degrees apart, so the fixture can be held on the machine table with the chuck or collet axis in either horizontal or vertical plane. One of these, which has sometimes been called a Super Spacer, can be fitted with either chuck or faceplate, for different kinds of work, and by changing special mask plates, errors are impossible on divisions of 2, 3, 4, 6, 8, 12, and 24.

Collet Fixtures

There is also available a collet index fixture, frequently seen on horizontal milling machines, on which a single handle opens and closes the collet, and also does the indexing. Any division from 2 up to 25 is possible with this fixture. Chips never cause any operating trouble because the oil is directed up through the collet to clean it out, even as it lubricates.

Seen in other places is an automatic chucking and indexing fixture of fairly similar type, but one in which the work is held in draw-in collets, that open and close automatically, and from which the work is ejected automatically. You can well imagine how this speeds up work adapted for handling on such a fixture. Work with 1, 2, 3, 4, 6, 8, 12, or 24 sides can be handled, and in some instances, over 1000 parts have been milled in an hour.

If there is one thing which more than all others serves to make the horizontal milling machine highly versatile, it is the application of various auxiliary milling attachments, by means of which different cutters can be used in different positions, relative to the work, and that can be arranged for with the machine as it stands.

Foremost among these, in those shops which have a variety of work, and which are not in position to have both a horizontal and vertical miller on the floor, is the vertical milling attachment. A horizontal machine, equipped with a vertical milling attachment, may be used for vertical end milling, face milling, T-slot machining, or even drilling and boring. Those who work on dies and metal patterns often find such an attachment highly convenient.

Attachment Cranes

Many manufacturers of horizontal millers provide such attachments for their machines. One has made three different attachments available for his machines, including a light duty, a medium duty, and a heavy duty type. The idea in this is to provide a light and easily handled unit for use where a heavier one is not required, and still furnish the others for use where more stamina is needed.

Means for facilitating the handling of these and other attachments is provided by this particular manufacturer, in the form of an attachment crane.

This is a special swinging bracket, that is attached to the top of the horizontal miller. It is so arranged as to hold the attachment suspended, in a "storage position," when it is not in use, and yet directly at hand for mounting and dismounting in a minimum of time.

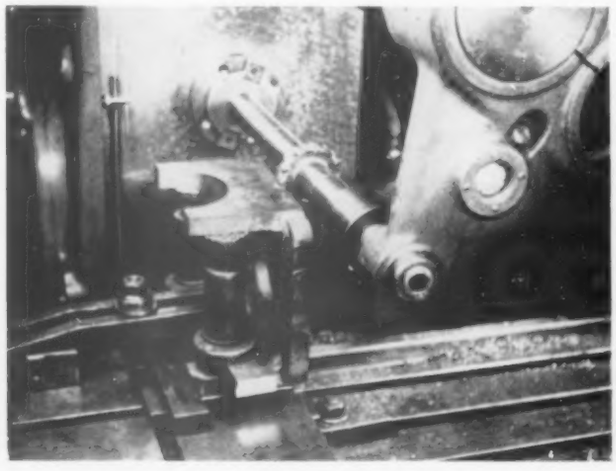
These vertical milling attachments, as supplied by milling machine manufacturers for use with their own machines, are usually so designed and attached to the miller as to receive their power from the milling machine spindle. There are, however, vertical milling attachments which attach to the milling machine overarm, and which have their own driving motor. A great speed range is obtainable, by interposed cone pulleys, or by some other means.

Some of these attachments are quite inexpensive, and are used for milling, drilling, boring, and facing operations, being particularly adapted for speed in making dies, tools, patterns, fixtures, and jigs. Some are particularly adapted for heavy duty milling, drilling, and boring operations. One is driven by an integral ½ hp motor, and is fitted with aluminum step cone pulleys which make available a speed range all the way from 250 to 3,000 rpm on the tool.

Where special vertical milling problems arise, there is always the proposition that the engineering department of a milling machine company may be able to develop some

FIG. 5. The time study man is on the job breaking down time study sequences, relative to use of fixture for holding large diesel engine connecting rods for milling on the Duplex Hydromatic Miller. Real production is obtained with a setup of this type. Photograph from Cincinnati Milling Machine Co., Cincinnati, Ohio.

FIG. 6. This adapter plate arrangement holds the workpiece at sufficient height above table to allow milling of slot without table interference. Since the cut is light, there is sufficient rigidity in this setup so that cutting forces will not spring the arbor. Photograph from Kearney & Trecker Corporation, Milwaukee, Wisconsin.



special attachment that will do the particular job involved as no standard attachment will. One such case concerns the mounting of face milling cutters so that they can be caused to move around obstructions, the particular job in mind being cylinder heads with a considerable number of bolt bosses, the tops of which were to be surfaced by face milling. However, there was a water inlet flange which stood quite a bit higher than the bosses, and it was necessary to avoid having the face milling cutters touch this flange.

In order to do this, a pair of sliding carriers were arranged on a horizontal slideway, above and across the milling machine table, each of these carriers being equipped with a vertical spindle, fitted with a face milling cutter. To mill all of the bosses, and still avoid striking the inlet water flange with the cutters, the two carriers were automatically controlled, in the proper cycle, on their sliding track, moving toward and then away from one another.

Control for this movement was a combination of mechanical and hydraulic, but it is too involved for consideration here. This is only one instance of what can be done if there is sufficient production to warrant designing and building special equipment.

There is another type of vertical milling attachment, provided for one line of machines, that has not as yet been mentioned. This is the so-called *compound* vertical milling attachment. There are two different ways in which this device can be mounted, in planes 90 degrees apart.

The spindle-carrying part of the compound attachment can be swiveled, making it adaptable for many different kinds of angular work, with regard to both crossfeeding and longitudinal feed of the table. It is excellent for milling angular strips, table ways, and like work, the full length of table travel being available in connection when desired.

End of Part I. The concluding installment, Part II, will be published in an early issue.—*The Editors.*

By Fred M. Burt

Highlights of California Industrial Exposition

ATTENDED BY MORE than 165,000 persons in its ten-day run from August 24 through September 2, in the Pan-Pacific Auditorium in Los Angeles, the Third Annual Southern California Industrial Exposition may be considered a huge success. About 100 exhibits represented over $500,000 in displays. In addition to the regular displays of machinery, tools, appliances and equipment, and many other products manufactured by local and West Coast manufacturers, a number of eastern and midwestern manufacturers exhibited their products.

As industry's attention today is directed not only to domestic commerce, but also to all the markets of the world, the Exposition chose as its principal theme, "Decalade of World Trade," which may be translated into a depiction of the various avenues of world commerce, such as manufacturing, distribution and transportation.

In line with the international aspects of such an Exposition, more than 5,000 buyers and exporters were invited as guests of the management, of whom large numbers attended. Invitations were also sent to the consuls of nations represented in the Los Angeles area. One of the feature exhibits of the Exposition was that of the World Trade Department of the Los Angeles Chamber of Commerce, arranged by Stanley Olafson, manager of the department. A booklet, entitled "What World Trade Means to You," was given to each visitor.

Besides great varieties of machine, hand and special tools, among the more sensational of the exhibits were a $40,000 aluminum house trailer; the new Darrin automobile which, with its low, streamlined plastic body, will be built in Los Angeles, and an electronic sandwich cooker.

Exhibitors secured many new dealers and customers, both in the United States and abroad, some as far away as Sweden and Australia. It was notable that, at the exhibits where orders could be taken for machine tools and many other units offered, salesmen were busily writing up orders. A fourth Exposition is planned for 1947, to be held in the same place.

By M. W. Seavey

"Blow-Up" Photos Facilitate Research and Inspection

Photographing Contour Projections on Optical Comparator Assists in the Control of Quality

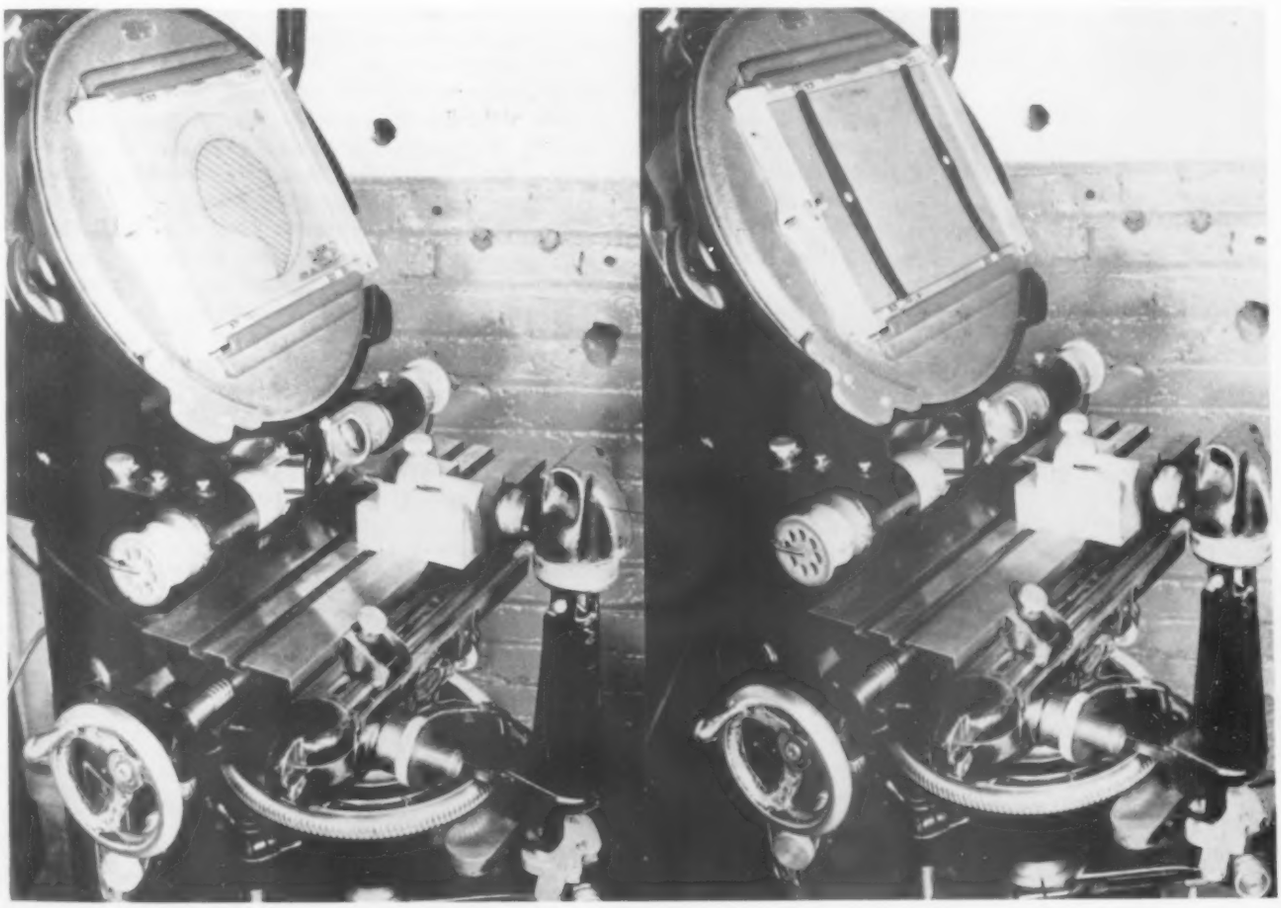
PHOTOGRAPHIC PRINTS or enlarged contours, as projected on an optical comparator (shadowgraph or contour projector) have been used in several research and inspection projects at Lockheed Aircraft Corporation. These pictures are used for record purposes, or as a basis for comment or criticism on variations found in a tool or part, through the use of the comparator. Being proportional, they become true-to-life, working pictures of the projected object.

Their use promotes analysis and interpretation of work results in relation to original forms, especially when such forms are altered by wear, processing, or testing. They provide a simple means of pointing out irregularities and reasons for rejections found in inspection.

Distortion effects upon certain forms, when heat treated or strain tested, may be studied by the use of this procedure. Before-and-after photographs made of a form projected against a grid screen laid out in .001 inch increments at the magnification used provides comparative data for detailed study. Photographic records, of a projection of each component part in some complicated performing equipment, can be kept as proof of quality maintenance in production and, later, could be referred to in the light of actual performances in determining reasons for varying actions.

Merton W. Seavey **learned metal working in a general machine shop, the while taking evening courses in machine shop practice, heat treating and metallurgy. After several years with Northrop Aircraft, he joined Lockheed in 1930 as a tool design checker and, during the war, conducted evening trade extension courses. At present, he is Tool Engineer in the Lockheed Manufacturing Research Dep't. In 1934, he helped organize Los Angeles Chapter, A.S.T.E., in which he is now Chapter Standards Chairman.**

FIG. 1. (Left) Router-cutter set up for reflection projection on Jones & Lamson, 14½-inch Optical Comparator. Chart-gage is shown in place of ground glass focusing screen in removable plate holder. (Right) Photo plate holder has been removed, loaded and returned, ready for exposure. The V-block holding the router-cutter was made special to hold the cutter with flat, ground end, correctly to give cross-sectional view when projected by reflection.



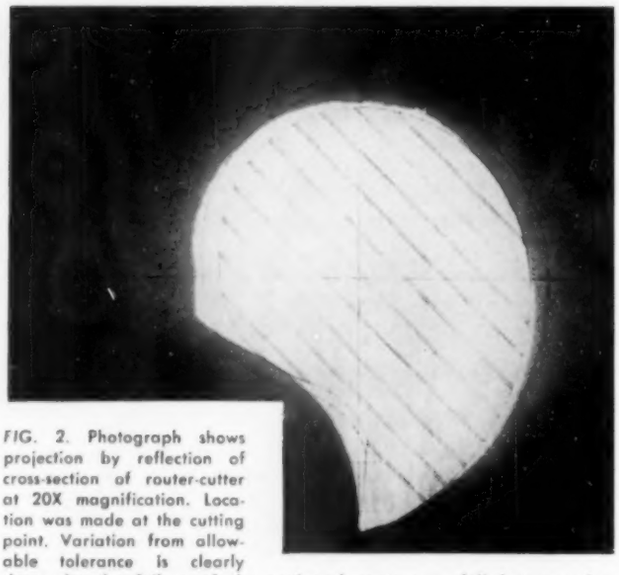


FIG. 2. Photograph shows projection by reflection of cross-section of router-cutter at 20X magnification. Location was made at the cutting point. Variation from allowable tolerance is clearly shown by the failure of the projected contour to fall between the maximum/minimum lines shown on the chart-gage.

Lockheed requires router-cutters in great quantities and obtains them from several sources. On investigation of why some cutters fail sooner than others, it was discovered that these router-cutters were of non-uniform cross section. See Fig. 3. Because such a cross section is practically impossible to measure by conventional instruments, the optical comparator was used. A chart-gage, being a magnified, proportional drawing of the desired cross section, was placed in the optical comparator and various router-cutters compared thereto.

Photo prints of the projected cross section, against the chart-gage, became basic records for analysis and inspection. Copies of the photographs were given to router-cutter manufacturers as an illustration of findings. Along with this, the company was able to provide exact duplicates of the ground glass chart-gage which allowed the supplier to use the same gaging method to arrive at the cross section required.

An optical comparator, or contour projector, is the basic machine used for this purpose. It provides a means of accurately enlarging a shadow of a tool or part to a know magnification. This may be done by direct projection of the contour, or reflected projection of a flat surface, especially where the outline of the detail sought is below the silhouette line. Several makes of these machines are available in a variety of models and with accessories for general or specialized use. A set-up on the comparator, and projection of the part to be photographed, is the necessary first step in the operation.

The resulting shadow on the view screen may be reproduced as follows: (1) A camera placed in front of and focused on the view screen. (The photographs, Figs. 4, 5 and 6 were taken this way); (2) Use of any light sensitized film or paper brought into direct contact with the view screen under photographic conditions, or (3) The use of properly "loaded" photo plate holders held by standard fixtures in place of the comparator's regular view screen, as shown in the picture Fig. 1. Pictures, Figs. 2 and 3, were taken by this method. At least two of the manufacturers of these projectors have these plate holding fixtures as standard accessories. Such equipment, naturally, provides the best results in finished photo prints.

Three Methods Available

There are three methods of making finished photographs tell a complete, dimensional story of the part photographed. First, a scale at the magnification used, may be placed on the view screen in a spot not to be covered by shadow. This should be on the glass, transparent or translucent, so it will print on the photo as the shadow is taken.

Second, a standard grid screen, as available from the Engineers Specialties Division of the Universal Engraving & Colorplate Co., Inc., 1919 E. 19th Street, Cleveland 15, Ohio, is a graphic means of providing comprehensive dimensioning throughout the entire shadow. This is a ground glass screen with a complete grid scaled in .001 inch increments at the magnification used. Any part of the form, being registered directly on the grid, is measurable to this detail on the finished photo.

Third, for best readable, or comparable purposes, the ground glass view screen should be a chart-gage of the part being reproduced. Ideally, this would be lines on the glass made to exact specifications, multiplied by the magnification, showing a basic outline, or minimum and maximum limits as desired, with scales in appropriate divisions indicated at critical points. A satisfactory material for this purpose, which is used at Lockheed, is the patented translucent engineers glass or detail engineers glass where a hard surface vellum is laminated to the surface of selected plate glass, acting as the ground surface or focusing plane for the shadow. Scale drawings of the contour desired may be made on this surface and used as the gage for the projected part, reference Figs. 1, 2 and 3. If the part is a standard

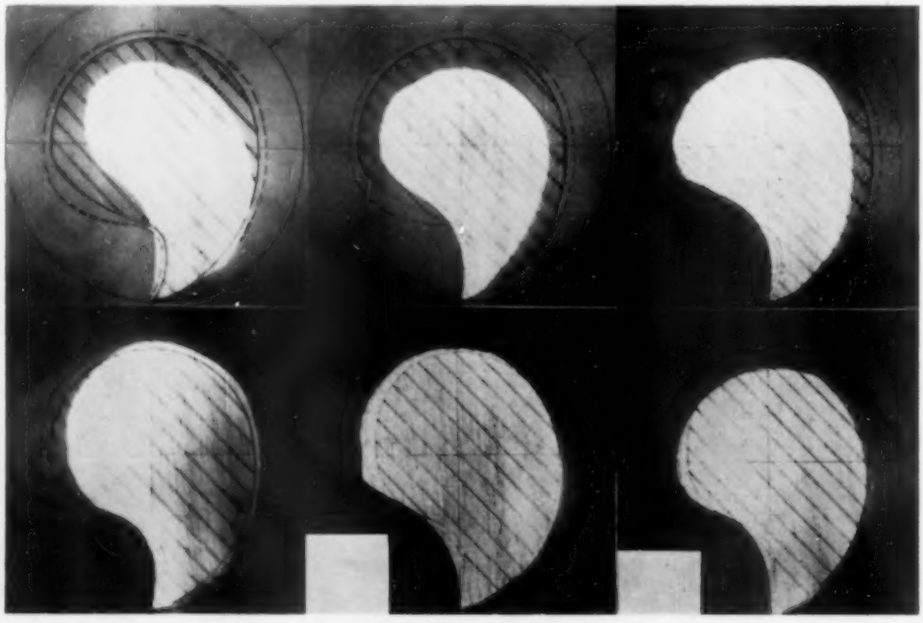


FIG. 3. Grouped photographs show comparison possibilities in research project where original contours may be recorded, break-down tests instituted, and results studied in the light of the photographs on hand.

...m or high precision is required, permanent chart-gages, ...ide to exacting tolerances on ground glass, may be ...tained from the same sources as the engineers glass.

Appropriate line-up of shadow and chart-gage in the plate ...lder must be made with the ground surface, or "line" ...le of the chart being toward the operator. This is im...rtant to prevent parallax, and requires alignment with a ...etermined gage point on the chart-gage, or some assur...nce that the variation from nominal in the part will be ...ccurately reflected by the same enlarged variation in the ...hadow when seen on the photograph. Coordination of verti...al and horizontal center lines of the chart-gage with the ...ame relative lines on the part is necessary. This may be possible with centers, V-blocks, or may necessitate a special fixture which would be aligned to set-lines on the chart by ...se of a master or setting part, depending upon the item being reproduced.

Commercial Grade Film Favored

When the shadow is correctly related to the chart-gage and focused thereon, the light on the comparator is turned off. If a photo plate holder is being used, the holder is removed and loaded with photographic film against the chart side of the glass. On the router-cutter research project at Lockheed, it was found that best results were obtained through the use of Eastman, commercial grade film.

This was selected because the timing can be controlled easier. For instance, if sensitized paper had been used, the time required for exposure would have been approximately 20 to 30 minutes, and this is too long a time to tie up a comparator. When Eastman Panchromatic Super XX film was used the exposure time required was only 1 to 2 seconds. It is difficult to operate the comparator in this short a time. The photographs, Figs. 2 and 3, shown in this article were made with the Eastman commercial grade film and the exposure time was 5 to 6 seconds. In taking this type of photograph a mirror-image will be obtained. In making or laying out the original chart-gage, be sure to check the optical system used on the comparator, because in some magnifications the shadow will appear in the same position as the part, and in other magnifications the shadow will appear inverted and reversed.

Standard precautions against light leakage should be exercised when returning the plate holder to the comparator. At all times avoid jarring or touching the original set-up. If this has happened, the shadow probably will not line-up with the chart-gage and the entire set-up will have to be re-made.

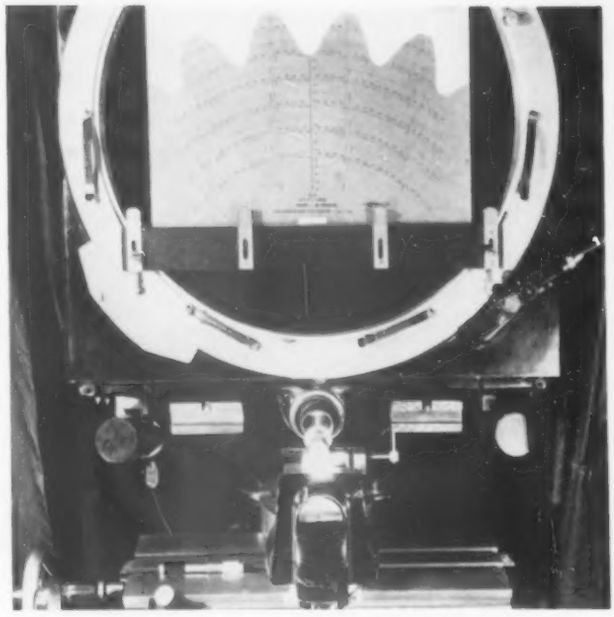


FIG. 4. Photograph of complete set-up of spline tooth lead check, using "washer," of shim sample hobbed at same time as spline, which is here mounted on plug and projected by direct projection.

Shadow is lined up to proper section of chart-gage giving scales on basic pitch circles. Comparator used in Jones & Lamson 22" Pedestal machine.

Line Orientation Necessary

Exposure is made upon removal of the plate slide from the plate holder and turning on the comparator light. Time will vary with such conditions as the light and speed of film, and probably will require some experimenting at first. On the router-cutter illustrated, where reflection projection was used, it was found that five seconds exposure was best. The end surface of the tool was ground to approximately a ten micro-inch finish to get the most usable reflection of the form.

When using the reflection method, bear in mind that in preparing the specimen it will be necessary to orientate the direction of the lines left by the grinding wheel if it is required to have certain sections of the specimen appear

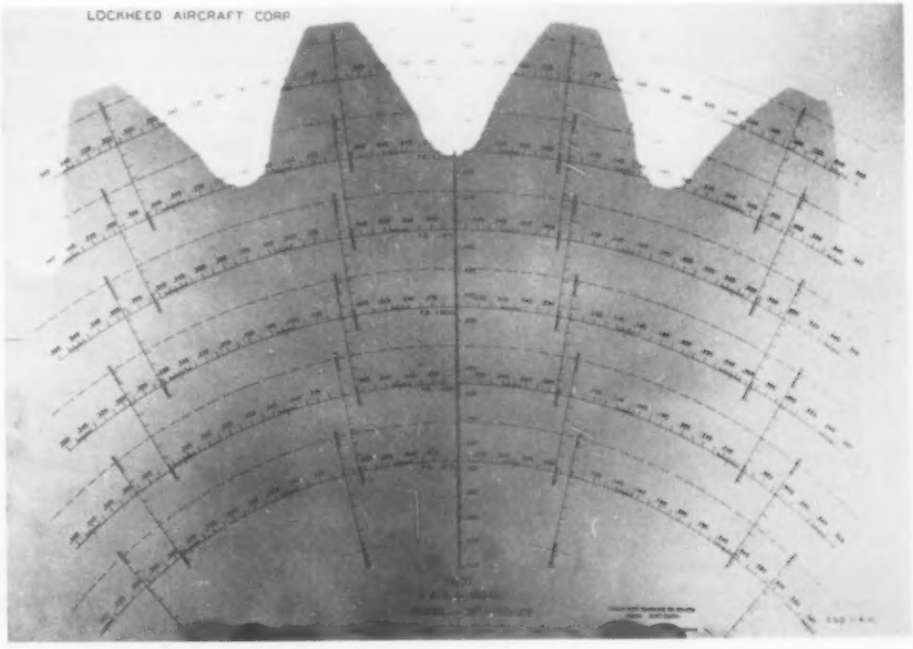
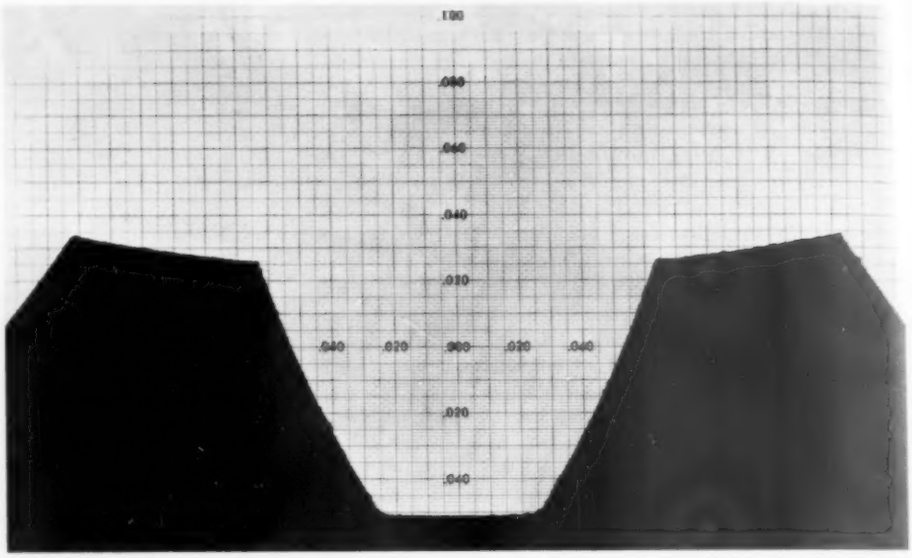


FIG. 5. Camera photograph of projection of spline referred to in set-up illustrated in Fig. 4. Actual size of screen is 11¼ x 16¾. Magnification is at 20X. Chart-gage was made for Lockheed by Engineers Specialties Division of The Universal Engraving & Colorplate Co., Inc., Cleveland 15, Ohio. It provides scales on basic pitch circle for measuring tooth spacing of six different size splines.

All photos used are from Photographic Dep't, Lockheed Aircraft Corp'n, Burbank, Calif.

FIG. 6. Internal spline tooth at 31½X magnification against grid graduated in .001".



in a given position. For instance, in Fig. 2, the cutting edge is down, and also is correct for the check gage. In order to obtain the maximum illumination, the lines left by the grinding wheels should be at right angles to the light beam source.

The shadow should reproduce gray, rather than black, so that the chart lines are readily visible in this part as well as in the light. This may call for over-exposure on reflected projection. In direct projection, where the shadow is naturally very black, an exposure of light between the object and the objective lens in the comparator may do the trick. This, of necessity, would have to be very quick and of considerable less intensity than that obtained from the projector light. It is only done to gray the shadow and allow printing of the chart lines covered by the shadow.

After exposure and upon removal of the plate holder for developing, caution should be used again to avoid moving or jarring the comparator set-up until after a satisfactory print has been obtained. If a re-take is necessary, it should be done at once to avoid having to re-set the entire machine.

As mentioned, a camera can be used and the entire screen of the comparator photographed as is shown in the illustration of the spline teeth. Direct measuring is difficult, and distortion is probable in the final results because of the likely non-parallelism or centralization between the view screen and camera film or plate. When direct print methods are used as described above, the result is full size, as shown in Fig. 2. Closely approximate scale measurements may be made at the magnification used, affected only by the shrinkage or stretch of the photo paper.

Investigation discloses that the film negative did not change dimensionally but that the print paper, after going through the print drier, stretched approximately 1/16 inch in the 8½ inch width direction, but the lengthwise dimension of 11 inches remained the same. This is mentioned at this time, to indicate that things made from paper should not be measured directly, and for same reason, one doesn't apply a rule to a blue print. It should be remembered, however, that the data shown on the photo print, or what you actually see, is correct.

The optical comparator has increased in popularity because of its ability to offer visual, precision gaging. And certainly, it seems entirely logical that the observable results should be preserved or made more widely available by the use of photography.

Mass Spectrometer at Work

As a sequel to a recent article—Mass Spectrometer for Industry, by Phil Glanzer in July '46 *The Tool Engineer*—the General Electric Spectrometer was recently put to a novel use. Ordinarily used to locate leaks in vacuum systems, the apparatus was here used by G-E engineers, working with the Consolidated Edison Company of New York, to check several aluminum transformers for leaks.

The cover plates of the transformers had 177 studs through each plate, and each stud had to be tested for oil tightness. While it was possible to use air pressure, this would have been a tedious procedure, with the possibility that the solution would penetrate through the studs with ultimate contamination of the oil when the covers were finally installed.

Use of the G-E Spectrometer type leak detector brought out a new application for the instrument, and quickly solved the problem. Since the instrument indicates the presence of helium, a can of this gas, under pressure, was applied to the head end of the stud under test and a valve opened to put approximately two pounds pressure of helium around the stud.

A suction cup, with a rough vacuum, was placed over the threaded end of the stud on the other side of the cover, and the leak detector was connected to this cup through a valve. Then, any helium which was sucked through the gasketed stud hole, in the plate, was indicated on the output meter. If, after 30 seconds, no reading was seen on the meter, non-leakage was indicated and the operation was then continued until all studs had been tested. Of the 177 so tested, only 3 were found faulty, while test time, even on a trial run, was reduced by a third.

A.S.T.E. NEWS

NEWS OF INTEREST AND ABOUT MEMBERS

Canadian Chapter representatives and National Officers in regional meeting, September 28, at Royal Connaught Hotel, Hamilton, Ont., to discuss national and local Society activities.

Chapters Study Individual, Joint Projects

Regional Groups Convene in Key Cities

IN FALL conferences conducted at several Chapter cities, the regional meeting of local ASTE groups, initiated earlier in the year, are being continued with the encouragement of the Board of Directors.

First Vice-President W. B. Peirce called a sectional meeting at Philadelphia, Pa., September 21, 7 Middle Atlantic Chapters sending 47 delegates to the gathering in the Bellevue-Stratford Hotel.

Mr. Peirce, in opening the meeting, explained that its purpose was to review and discuss the Society's procedures. Continuing, he briefly sketched the organization's activities and answered questions from the assembly, concerning the status of various projects.

Many Topics Introduced

Subjects discussed included: National assistance in Chapter educational work; integration of individual Chapter regulations with those established by the Society; membership for G.I. students past the age limitations prescribed for Student Membership; progression of Chapter officers, and voting by proxy.

Among other topics presented were: appointment of assistants to committee chairmen, Nominating Committee procedure, financial routine, and the retention of retiring Chapter Chairmen on Executive Committees.

In his closing remarks, Mr. Peirce urged a thorough study of the operational procedures by all Chapter officers in order to better equip themselves for executing the duties of their respective assignments.

Attending the meeting were: H. W. Gross, Chm.; A. R. Diamond, 1st V. Chm.; S. R. Boyer, 2nd V. Chm.; W. W. Cady, Secy.; H. F. Holden, Treas.; J. W. Noble, Constitution and By-Laws Chm.; Emil Kitzman, Membership Chm.; L. S. Subber, Standards Chm.; J. P. Clark, Jr., Public Relations Chm.; A. S. Elston, Education Chm.; F. M. Crayton, Natl. Education Com.; P. A. Patterson, Industrial Relations Chm.; Joseph Danihel, Jr., Entertainment Chm.; and T. J. Donovan, Jr., Natl. Constitution and By-Laws Com., all of Philadelphia Chapter.

W. D. Winger, Chm.; and T. F. Burke, 2nd V. Chm., Baltimore Chapter; W. G. Vernon, Chm.; S. E. Sheffer, 2nd V. Chm.; J. H. Smart, Editorial and Public Relations Chm.; P. F. Leese, Entertainment Chm.; H. D. Jones, Standards Chm., Central Pennsylvania Chapter.

J. L. Webster, Chm.; E. T. Ross, 1st V. Chm.; C. B. Carlson, 2nd V. Chm., and H. W. Ryno, Secy., Northern New Jersey Chapter; T. P. Orchard, 2nd V. Pres.; H. S. Hunt, 1st V. Chm.; E. J. Novack, 2nd V. Chm., and Julius Schoen, Secy., Greater New York Chapter.

R. T. Plitt, Chm.; R. P. Thayer, 1st V. Chm.; H. M. Frazier, 2nd V. Chm.; and J. D. Anderson, Membership Chm., Potomac Chapter.

Williamsport Sends Large Group

J. L. Strasburg, Chm.; L. H. Bardo, 1st V. Chm.; D. M. Lowrey, 2nd V. Chm.; C. R. Winter, Jr., Secy.; D. C. Brown, Treas.; E. H. Sears, Editorial Chm.; W. J. McCoy, Membership Chm.; S. W. Matthews, Public Relations Chm.; D. D. Hennigan, Education Chm.; H. O. Hallman, Entertainment Chm., and J. H. Shafer, Advisory Chm., Williamsport Chapter.

The Pittsburgh Chapter delegation consisted of G. C. Wood, Treas., and Mr. Peirce.

* * *

At Hamilton, Ont., W. A. Dawson, Natl. Asst. Secy.-Treas., presided over a Canadian regional meeting, September 28, in the Royal Connaught Hotel.

The agenda, prepared by a committee consisting of J. N. Walton and J. E. Ball, Chm. and Secy. of Hamilton Chapter, and Mr. Dawson, was submitted for approval to the 31 delegates and National Officers present.

Communications were read from Pres. A. M. Sargent, Natl. Constitution and By-Laws Chm. R. H. Morris and Natl. Editorial Chm., W. B. McClellan, expressing regret that they or their committeemen could not attend the meeting, the latter two inviting suggestions for

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Canadian appointments to their committees.

Chairman Dawson introduced V. Pres. Peirce who outlined the preparation of the revised Constitution and By-Laws and procedures, and the functions of the Public Relations, Editorial, Program and Education Committees which are under his direction.

Executive Secretary H. E. Conrad of the Detroit office gave a resume of Headquarters operations, including the publication of the ASTE Directory and *The Tool Engineer*, and the "Tool Engineers' Handbook."

C. D. Wright (Hamilton) Canadian member of the Natl. Education Com., reported on the activities of that body, emphasizing the engineering texts being prepared.

Transfer of the bulk of Canadian deposits to the Society's Detroit banking house was recommended after L. G. Singer (Toronto) of the Natl. Finance Com. had pointed out that the Canadian and U. S. dollars are now parred.

Plans for securing a 10% increase in membership were announced by J. M. Rudel (Montreal) of the Natl. Membership Com.

New Speaker and Film Lists

Mr. Peirce, reporting for the Natl. Program Com., stated that a new directory of technical speakers, as well as a list of educational films, is being compiled. He stressed the desirability of developing speaking talent within the Chapter membership.

The Society's efforts in building good will through publicizing its activities, to achieve recognition in industry as the authority on production and tool engineering, were described by R. E. Crawford (Toronto) and H. H. Whitehall (Hamilton) of the Natl. Public Relations Com.

W. A. Thomas (Windsor) Chairman of the ASTE Natl. Standards Com., related various projects under way in that field, one of the more recent being the geographically-assigned standardization program. He indicated favorable response from Canadian manufacturers interested in issuing data sheets for distribution to members in that country.

The chair answered a number of questions in the ensuing discussion concerning the committee reports. Before adjourning, the group voted to convene again two weeks before the 1947 Annual Meeting.

Chapters Well Represented

In addition to the presiding officers and the reporting committeemen, attendance at the meeting included: J. N. Walton, Chm.; W. A. Alexander, 1st V. Chm.; Gordon Hall, 2nd V. Chm.; George Gilmour, Treas.; J. E. Ball, Secy.; L. C. Brasier, Public Relations Chm.; R. J. Clench, William Barlow, Werner Werthmiller, Standards Chm.; J. M. Snyder, Constitution and By-Laws Chm.; and R. T. Vincent, Education Chm., of the host Chapter.

W. W. Appleton, Chm.; Joseph Row, Editorial Chm.; and E. L. Greer, Toronto Chapter; H. T. Welch, 1st V. Chm., and G. S. Clarke, 2nd V. Chm., Montreal Chapter; W. B. Moore, Chm., Windsor Chapter; E. G. Dewar, Chm.; W. J. Sawerly, a guest; Henry Hendriks, Past Chm.; and C. G. Bradford, Treas., of Niagara District Chapter.

* * *

Ten Midwestern Chapters sent 31 delegates to a regional meeting at Hotel Morrison in Chicago, Ill., on Sept. 29.

President A. M. Sargent, introduced by L. J. Radermacher (Milwaukee), retiring Director, reviewed the history of the Society, its present international character, and the functions and duties of the several committees. Members, he stressed, should be ready to accept National office when it is offered. He also pointed out the missionary work required in plants and shops still unfamiliar with ASTE.

Handbook to Come Out in '47

Reporting on the progress of the "Tool Engineers' Handbook," B. C. Brosheer (Chicago), a member of the Handbook Committee, stated that 90% of the contents had been assigned to contributors and that publication could be expected the latter part of 1947.

Cycle billing of membership dues is to be inaugurated by the Central Office, Mr. Radermacher announced. The annual invoicing, from date of acceptance to membership, will spread this operation over the entire year, facilitating the procedure at the Detroit office and aiding Chapter Secretaries in following up on dues expirations.

The Society procedures, Mr. Sargent indicated, will be reprinted each year with minor additions and corrections. After explaining the duties of the Program Committee, he answered questions from the floor, concerning program activities.

In response to an inquiry about Chapter purchase of film projectors through the National Society, Mr. Sargent pointed out that in some cities it is impractical to own projection equipment because of union regulations. Costs of using such machines, with union interference, would be as great as for rental equipment, he said.

Members Like New Roster

In commenting on the recently issued ASTE Directory, Mr. Sargent remarked that it fills a long felt need in enabling members and Chapters to contact each other.

Throughout the discussion, the Society's President answered questions from the delegates, concerning Chapter activities and problems.

Representing Chicago Chapter, in addition to Mr. Brosheer, were: C. B. Cole, National Director; Clare Bryan, Chm.; O. W. Strid, F. J. Schmitt, 1st V. Chm.; H. M. Taylor, 2nd V. Chm.; R. F. Erickson, Secy.; and Frank M. Kincaid, Standards Chm.

Out of town officers, besides Messrs. Sargent and Radermacher, included: L. J. Kaufman, Chm.; Jule Schommer, 1st V. Chm.; and D. G. Storms, Secy., Fond du Lac Chapter; J. G. Astrom, Chm., Fort Wayne Chapter.

D. R. Smith, Chm.; G. R. Duncan, Public Relations Chm.; and H. R. Allen, Reservations Chm., Indianapolis Chapter; R. H. Ford, Chm.; P. E. Butzin, 1st V. Chm.; R. H. Rosenthal, Program Com.; P. O. Wernicke, Public Relations Chm.; A. C. Gudert, Constitution and By-Laws Chm.; and Joseph Ebner, 2nd V. Chm., Milwaukee Chapter.

C. B. Hartsock, Chm.; and J. O. Knight, Delegate, Peoria Chapter; E. Y. Seborg, 1st V. Chm.; H. A. Nelson, 2nd V. Chm.; H. A. Loy, Membership Chm.; and E. L. Collin, Standards Chm., Rockford Chapter.

J. J. Demuth, Chm., St. Louis Chapter; H. R. Wentzell, Natl. Constitution and By-Laws Com., South Bend Chapter; and L. N. Dahlen, 2nd V. Chm., Tri-Cities Chapter.

Racine, Decatur, and Fox River Valley Chapters were unrepresented.

* * *

Another mid-country group met at Richmond, Ind., October 6, with 25 representatives from Cincinnati, Columbus, Dayton, Fort Wayne, Muncie and Richmond Chapters.

With Jesse Johnson, Richmond Chapter Chairman, as presiding officer, the

Mayor Welcomes ASTE To Detroit Meetings

Detroit, Mich.—Announcement of the cancellation of the ASTE Semi-Annual Meeting, scheduled for Pittsburgh last month, and the transfer of Board of Directors and National Committee meetings to the Society's headquarters city, brought a welcome from Detroit's Mayor Edward J. Jeffries, Jr., offering the facilities of the automotive metropolis.

In extending the city's hospitality to A. M. Sargent, the ASTE President, Mr. Jeffries expressed the hope that Michigan's largest industrial community might have the privilege of entertaining the Society during one of its expositions. When conditions permit construction of Detroit's projected civic development, the big tool and die center can readily house a show of the magnitude of the 1946 ASTE New Era Exposition, the Mayor indicated.

Edward J. Jeffries, Jr., (right) Mayor of Detroit, offers ASTE President A. M. Sargent keys to the city for the Society's fall meetings of the Board of Directors and National Committees.

Formerly held in Detroit's Convention Hall, the Society's educational exhibits have now outgrown the facilities of the block-square building.

Decision to postpone indefinitely the 14th Semi-Annual Meeting was reluctantly made when it became apparent that there was no prospect for early settlement of the power, transportation, and hotel and restaurant workers strike, partially paralyzing Pittsburgh commerce and industry.

Through the co-operation of Western Union's commercial service, it was possible to immediately notify each member of the Society that the convention would not be held. ASTE members planning to attend the Pittsburgh meeting have expressed appreciation of the individual telegrams enabling them to rearrange their personal schedules.

Despite the prompt action by the Society's National Officers, one West Coast committeeman, already en route, made the fruitless round trip to Pittsburgh.

LETTERS *from the President*

NO. 1, CONDUCT OF THE HOUSE OF DELEGATES

Greetings:

In this, the first of a series of letters, I feel that we should give primary consideration to the operation of the House of Delegates and to the problems arising in the conduct of its meetings.

This body is the foundation upon which has been built as democratic a society as is possible to obtain. In its first meeting last April, many subjects were discussed. These are among the problems of organization and procedure that were faced:

CREDENTIALS COMMITTEE—As was inevitable, the problem arose of electing a Credentials Committee before such Committee had determined who could vote. Yet this is a simple matter. It is assumed that the Delegates come with proper credentials, are honest men, interested and sincere. Therefore, it appeared the logical expedient to let the Delegates work out a procedure among themselves.

CLOSED MEETING—The purpose of the closed meeting as specified was to provide constitutionally conditions under which Chapter representatives could freely discuss candidates being considered for election to the Board of Directors, or to Honorary or Life Membership.

PROXIES — During the proceedings, the subject of Proxies was discussed. Throughout the thinking of the Organization Progress Committee, in devising the suggested procedures, every effort was made to maintain the official standing of the individual Chapter so that any action of the House of Delegates would truly and accurately reflect the desires of the individual members and of the elected Chapter officers.

NOMINATING COMMITTEE — It is obvious that the Nominating Committee submits nominations on the basis of information not readily available to all the Delegates. Members of the Nominating Committee are appointed because of their wide knowledge of individuals active in the operation of the National Society and because of their equally intimate knowledge of the actual duties of the various officers. The Nominating Committee, in the course of its deliberations, must have studied the ambitions of the candidates, their ability to function properly, their personality, intelligence, judgment and tact.

Provision was made in the Constitution for special Nominating Committees in the event of regular nominations unacceptable to the Society. These special Nominating Committees have every right to nominate any individual or a complete new slate, as they see fit. However, they should make certain that their candidates fulfill all of the practical requirements previously outlined.

It is obvious that, with a small Board of Directors, the House of Delegates cannot afford to make the serious mistake of electing popular men who are not good administrators or workers.

CHAPTER INSTRUCTION OF DELEGATES —Special nominations made from the floor of the House raised several problems as to the Chapters' instructions to their several Delegates.

It was the intention of the Organization Progress Committee to provide for the instruction of the Delegate by the Chapter or the Chapter Executive Committee. But it was assumed that the Chapter would either instruct him to adhere rigidly to their instructions in the matter of voting, or to use his own judgment in a discretionary way.

The latter is usually the better method, since frequently the Delegate will find himself confronted, in the course of an election, by a situation which could not possibly have been anticipated in advance by his home Chapter.

METHOD OF BALLOTING—A discussion arose concerning determination of the election of a Director when his first majority had been attained.

It was felt that a little extra time in voting on a matter so inherently important to every one of our eighteen thousand members would be of the least consequence, and, therefore, it would be advisable to follow the standard parliamentary procedure of dropping names from the bottom of the list until ten candidates had acquired a majority of the votes cast.

An experimental check of the two means of balloting would indicate considerable difference in the final result. Unquestionably, a very few votes for some of those who did not quite attain the majority vote on the first ballot would have reversed the status of three or four individuals.

This becomes even more important in the light of the provision contained in Division 1, Page 3, Lines 68-74: "Should a vacancy be created in the Board of Directors, the candidate receiving the next highest number of votes at the preceding election of Directors by the House of Delegates shall succeed to fill the vacancy."

This clause in the Constitution makes it mandatory that the record list the runner-up in such an election.

* * *

It was quite natural that these and other problems would manifest themselves at the initial meeting. In fact, the results were most gratifying to the Organization Progress Committee, justifying their hopes for the strong, democratic participation of every member in the National affairs of this, one of the most vigorous and forward-looking engineering societies in the nation.

Your discussion of these matters with your Chapter executives will insure a continuity of thinking and an even smoother functioning organization in the world.

A. M. SARGENT, *President*
AMERICAN SOCIETY OF TOOL ENGINEERS

Lapham and Kassebohm On Editorial Committee

Detroit, Mich. — John A. Lapham, Process Analyst for Consolidated Vultee Aircraft Corp., Fort Worth, Texas, and Walter Kassebohm, General Manager of Production Engineering Co., Berkeley, Calif., have been appointed members of the ASTE National Editorial Committee, W. B. McClellan, Chairman of the Committee, has announced.

J. A. Lapham

Walter Kassebohm

Mr. Lapham has served as National Director, Aesthetic Committee Chairman, Southern Area Vice-Chairman of the National Membership Committee, and Secretary and Treasurer of North Texas Chapter.

Mr. Kassebohm, who is also a former Director, was the first Secretary of Golden Gate Chapter, became its First Vice-Chairman and two-term Chairman.

Shrink Fits with Oxygen

Richmond, Ind.—A demonstration of liquid oxygen was given by Robert Meyers of the Indiana Oxygen Co., Indianapolis, at the second anniversary meeting of Richmond Chapter, held September 10 in the Leland Hotel.

Liquified, the remarkable gas was used by Mr. Meyers at 325 degrees below zero, Fahrenheit, to almost instantly freeze several varied objects. The liquified oxygen is used in welding and by automotive manufacturers to obtain shrink fits of almost unbelievable holding power, the speaker said.

Dinner music was provided by the "Ladies in Red."

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conferees made a thorough study of the program of the National Membership Committee, offering a number of suggestions for building membership and attendance.

In a discussion of educational activities, it was announced that Cincinnati Chapter invites co-operative students from the University of Cincinnati to Chapter meetings. Richmond Chapter, whose meeting guests include veterans in on-the-job training, reported plans for sponsoring a student for one year at Purdue University.

Members present at the area meeting were: R. E. Lockridge, Past Chm.; J. L. Newcomer, Entertainment Chm.; M. E. Culbertson, Public Relations Chm.; M. T. Moore, Membership Chm.; and L. B. Penland, Secy., Richmond Chapter.

Lorin Hayden, Chm.; Al Schlattner, Past Chm.; and G. H. Simon, Public Relations Chm., Cincinnati Chapter; W. E. L. Bock, Chm.; W. K. Armagost, Treas.; and S. M. Mack, Standards Chm., Columbus Chapter.

Adam Lensch, Chm.; G. C. Tillotson, Past Chm.; C. R. Miller, Secy.; C. W. List, Treas.; R. A. Miller, Membership Chm.; and J. R. Kuntz, 2nd V. Chm., Dayton Chapter: E. G. Chambers, 1st V. Chm.; and Everett Keese, Membership Chm., Fort Wayne Chapter.

W. H. Vickers, Chm.; R. L. Waters, 1st V. Chm.; E. D. Myers, Membership Chm., N. F. Wilson, Public Relations Chm.; and R. L. Wiemer, Entertainment Chm., Muncie Chapter.

Other sectional meetings, held at Springfield, Mass., and Syracuse, N. Y., will be reported in a later issue, as the minutes are received.

Figure of Benjamin Franklin, early American scientist, lends impressive dignity to setting for Philadelphia Chapter Executives Dinner, September 19, at Franklin Institute. Among guests of honor were: (2) D. W. R. Morgan, Gen. Mgr., Steam Div., Westinghouse Electric Corp.; Dr. G. H. Brown (principal speaker), Research Director, R.C.A. Laboratories; (H. W. Gross, Chm., Philadelphia Chapter); W. B. Peirce, 1st V. Pres., ASTE; Dr. Stanley Morehouse, Dean of Engineering, Villanova College; (3) H. S. Harris, Secy., Engineers Club, Philadelphia; C. N. Hoyler, Staff Asst., R.C.A.; L. W. Johnson, Ind. Heat Specialist, General Electric Co; S. T. Mackenzie, Chm., Philadelphia Section, ASME; F. W. Miller, Works Mgr., Yarnall-Waring Co.; (4) M. C. Batsel, Chief Eng., R.C.A.; George Bass, Pres., Ferracute Machine Co.; C. P. Boyd, Pres., Charles P. Boyd Co.; E. R. Brodin, Asst. V. Pres. in Charge of Mfg. and Research, S.K.F., Ind.; (5) W. R. Coley, V. Pres. in Charge of Production, Leeds & Northrup Co.; Dr. James Creese, Pres., Drexel Institute; George Daum, Chief Prod. Eng., Philco Corp.; Joseph Friel, Pres., Reber-Friel Co.; and Prof. L. N. Gulick, Asst. to Dean, Towne Scientific School, U. of P. (6) Partial view of the 230 members and guests.

Executives Hear Educational Plans

Two Colleges Offer Cooperation

Brown Talks on "Research Engineering"

UNDER THE shadow of Benjamin Franklin, in the hall bearing his name at famous Franklin Institute, Philadelphia Chapter met September 19 to honor local industrialists and educators and inform them of the Society's efforts in their respective fields.

Principal speaker at the Executives Dinner was Dr. George H. Brown, Director of Research, R.C.A. Laboratories, Princeton, N. J.

In his address, "Research Engineering," Dr. Brown described applications of induction heating, on both metallic and non-metallic materials, dwelling at length upon the subject of steel hardening.

His lecture was profusely illustrated with slides and a colored film. At the conclusion of his discussion, he showed contributions made by R.C.A. in treating penicillin and milk by induction heating.

Assisting Dr. Brown was Wendell C. Morris, Research Engineer at the Princeton laboratories.

Before the opening of the technical session, W. B. Peirce, First Vice-President of the Society, reported on the progress of improvements at the Detroit office, emphasizing the new mechanical accounting system and the services and activities of the organization.

Alfred S. Elston, Chapter Education Chairman, in reviewing activities of his committee, stressed the necessity of both training and experience in developing the well-rounded tool engineer.

He referred to the ASTE courses at Spring Garden Institute, from which 130 students of Die Design and Tool Design have been graduated. Present enrollment in the tool engineering courses is 78, Mr. Elston said.

U. of P. Co-Sponsors Lectures

Pointing to the expanding field of ASTE educational effort, now being extended to the joint sponsorship of lectures in local colleges, Mr. Elston announced the cooperation of the University of Pennsylvania through Prof. Lee N. Gulick, Assistant to the Dean, Towne Scientific School, and a guest at the dinner.

The lectures will be open to University students and to the entire membership of Philadelphia Chapter on evenings not conflicting with regular meeting nights.

(At the conclusion of the meeting, another guest, Dr. Stanley Morehouse, Dean of Engineering at Villanova College, signified his immediate interest in inaugurating a similar course of lectures at his college.)

Rev. O. L. Schumpert, S.T.D., and a graduate engineer, offered the invocation preceding the dinner.

Invited guests included M. C. Batsel, Chief Engineer, and C. N. Hoyler, Staff Assistant, Radio Corp. of America; George Bass, President, Ferracute Machine Co.; Charles P. Boyd, President, Charles P. Boyd Co.; E. R. Brodin, Assistant Vice-President in Charge of Mfg. and Research, S.K.F. Industries; W. R. Coley, Vice-President in Charge of Production, Leeds & Northrup Co.; Dr. James Creese, President, Drexel Institute; George Daum, Chief Production Engineer, Philco Corp.

Joseph Friel, President, Reber-Friel Co.; D. W. R. Morgan, General Manager, Steam Div.; A. C. Fulton, Manager, Mfg., Steam Div.; and Edward A. Snader, Section Engineer, Metallurgical Engineering Dept., Westinghouse Electric Corp.; Henry S. Harris, Secretary, Engi-

neers' Club; K. T. Sorensen, Vice-President, William Sellers Co.

Emil Schafer, Works Superintendent, and L. W. Johnson, Industrial Heat Specialist, General Electric Corp.; S. T. Mackenzie, Chairman, Philadelphia Section, ASME; F. W. Miller, Works Manager, Yarnall-Waring Co.; George M. Muschamp, Vice-President in Charge of Engineering, Brown Instrument Co.; E. J. Parker, Assistant General Manager, ACF-Brill Co.

Dwight H. Renfrew, General Superintendent, Link-Belt Co.; Richard Swartz, President, Crown Can Co.; John Whitesell, Project Engineer, Red Lion Plant, Edward G. Budd Co.; and William A. Williams, Chief Engineer, American Pulley Co.

Out-of-Town Officers

Visiting officers, among the 230 attending the function, were: Ray H. Morris, National Constitution and By-Laws Chairman, ASTE, of Hartford; W. Daryl Winger, Chairman, and Nils Lou, former National Director and Chairman, Baltimore Chapter; Robert T. Plitt, Chairman, Potomac Chapter; R. J. Miller, Past Chairman, Chicago Chapter; and G. C. Wood, Treasurer, Pittsburgh Chapter.

The successful function was carefully planned in a series of meetings of Chapter officers and committee chairmen. Prominent in the arrangements for the affair were First Vice-Chairman Arthur R. Diamond and Second Vice-Chairman Samuel R. Boyer, aided by Chairman Howard W. Gross and Delegate Thomas J. Donovan, Jr.

125 Hear Welding Talk

Fort Wayne, Ind.—September meeting of Fort Wayne Chapter was held on the 11th in the Chamber of Commerce Auditorium with 125 engineers present for the address by Edward Holt, Metallurgical Research Engineer of P. R. Mallory & Co., Inc., Indianapolis.

Mr. Holt illustrated his talk on Resistance Welding with a series of slides.

After the lecture, the members examined a display of samples of resistance welding.

Other speakers were Mayor Harry Baals and Carl Vogelgesang, Chief Engineer of the Indiana State Highway Commission. Mr. Vogelgesang conducted the first sponsored discussion ever presented concerning the proposed Fort Wayne express highway system.

Special guests included representatives of nearly all other engineering societies in Fort Wayne.

Plans were made for a visit to the local plant of the International Harvester Company, featuring an inspection tour of the drop-forging shop and heat treating department.

Situations Wanted

MECHANICAL ENGINEER — Seeks connection as chief engineer, assistant chief engineer, or a position of equal executive responsibility. Ten years' experience in mechanical and tool engineering, including four years as owner of tool, die and gage manufacturing business. Graduate M. E. Connecticut location preferred. Write Box 103, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Mich.

Honor Bestowed on ASTE Unique in Americas

Atlanta, Ga.—No other society in the Western Hemisphere has been accorded the recognition conferred on ASTE in the award of the fourth honorary membership in The Institution of Production Engineers, Great Britain, A. M. Sargent, ASTE President, told Atlanta Chapter members during an address at a meeting held September 12 in the Georgia Tech Banquet Hall.

A. M. Sargent

In referring to this signal honor, Mr. Sargent displayed the membership certificate, as well as a replica of the IPE coat of arms, and several letters from officers of the English organization.

Discussing the aims and organization of ASTE, he traced the Society's establishment in the early '30's by the five original founders, through its phenomenal growth, to its present international membership.

In thanking Mr. Sargent for his presentation, J. C. Cogburn, Jr., Atlanta Chapter Chairman, remarked that he expected the President's address to inspire the Chapter with new zeal for greater progress and achievement.

Approximately 45 members and guests attended the dinner meeting.

Fluorescent Penetration, Magnetic Particle Tests

Cincinnati, Ohio—D. P. Walsh, District Sales Manager from the Detroit office of Magnaflux Corp., spoke before 80 members and guests at the first fall meeting of Cincinnati Chapter held September 10 in the Engineering Society Headquarters.

D. P. Walsh

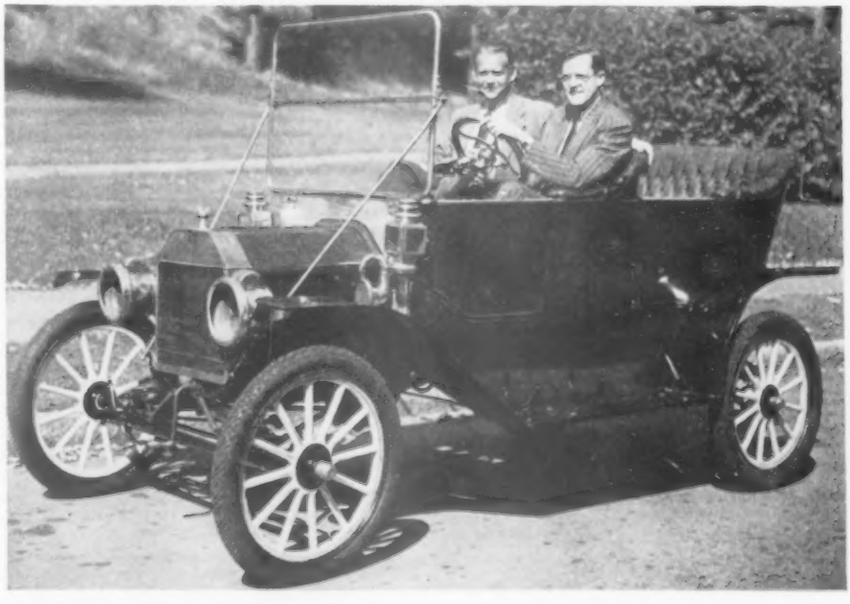
Mr. Walsh's talk, "Practical Tool Inspection and Quality Control Methods," concerning perishable tool inspection and maintenance inspection of machinery, was illustrated with slides, and samples displayed under black light.

The speaker thoroughly explained both Magnaglo, the magnetic particle inspection used for all magnetic types of steel, and Zyglo, black light inspection employed in examining all non-magnetic materials, such as carbides. The complete text of Mr. Walsh's paper will appear in an early issue of *The Tool Engineer*.

Before the technical session, dinner was served in the dining room at the Society Headquarters. George Squibb, Program Chairman, outlined the schedule of speakers for the season.

Give to Your Community Chest

'New' Car Makes Picnic Destination on Maiden Trip



Worcester, Mass. — When Worcester Chapter staged an outing, September 21, Alden P. Johnson, President of Johnsonde Vou, Inc., solved the problem of transportation for himself and the company's Vice-President, V. H. Ericson, with his "new" car—of 1911 vintage.

Completely overhauled and resplendent with a fresh paint job, the 35-year-old Ford made the round trip to the Hillcrest Golf Club in Leicester with no mechanical difficulties of any sort.

Only infirmity handicapping the antique vehicle was the lack of lights. On the return trip in the twilight, the renovated automobile was convoyed between two cars of more recent origin, equipped with the necessary illumination.

Both men are members of Worcester Chapter. Mr. Johnson's business associate, Mr. Ericson, is National Treasurer of the Society.

Dr. Hilton Ira Jones of Hizone Research Laboratories, Wilmette, Ill., displays nylon rod to (left to right) C. B. Hartsock, Peoria Chapter Chairman; W. M. Owen, technical chairman; and H. E. Conrad of Detroit, ASTE Executive Secretary. Dr. Jones presented his lecture, "Peeps at Things to Come," before Peoria Chapter members at their September 17 meeting.

Jet Rocket Safeguards Aircraft in Take-Off

Los Angeles, Calif.—"Jato—Jet Assisted Take-Off," was the timely subject discussed at a recent meeting of Los Angeles Chapter.

Sponsored by Aerojet Engineering Corp., the program was presented by Elmer E. Nelson, Chief Test Pilot and Sales Manager, and W. L. Rogers, 25-year-old Senior Design Engineer for the company.

Many sequences of the motion picture they showed were filmed at Dayton, Ohio, demonstrating a number of Jato take-offs. Looking something like an acetylene tank, the Jato unit weighs 200 lbs. loaded.

While earlier models delivered a thrust of 200 lbs. for an interval of 8 seconds, this modern rocket exerts 1000 lbs. for 12 seconds. The propellent cartridge, 9" in diameter x 23" in length contains a mixture of asphalt and oil as fuel and potassium perchloride as oxidizer.

The cartridge is enclosed in seamless tubing, spun down at one end. Capped with a foot designed for storing the rocket upright, the other end is provided with handles. The foot is attached to the tube by means of a 12 pitch buttress thread.

Carbon Insert Resists High Heat

The nozzle, as shown in the film production, consists of a screw machine part threaded into the tube. On the outside is a tapered orifice of about ¾" in diameter at its smallest point. On the inside it carries a carbon insert, the only material that would withstand the high temperatures of the burning gases. The orifice is sealed with a copper disc which blows out at 2000 psi, the operating pressure of the unit.

This pressure, required to burn the charge properly, protects the unit against accidental firing. Dropping an unused Jato unit or making a "belly landing" will not cause it to ignite. A small charge of black powder, ignited in turn by a nichrome wire in an electrical circuit, is necessary to start combustion.

Another safety feature is the pressure relief valve. While the design pressure is 2000 psi, the steel cartridge is tested at 4500 psi, with pressure relief blowing at 3500 psi.

Power developed during the operating period was stated to be extremely high—in a two-motored plane, sufficient to effectively replace one of the engines during the take-off.

Main feature of the device, the speakers explained, is the reserve of power available in the event that an engine should fail during take-off, preventing the pilot from bringing his plane to a stop before overshooting the runway and crashing.

In such emergency, the pilot presses a switch and, after an ignition lag of only 0.2-0.5 seconds, sufficient power is available to climb to a safe altitude where he can fly his ship without the disabled engine, and return for a safe landing.

Just as the reversible pitch propeller is used to shorten the landing distance, so Jato is employed to reduce the take-off run.

At an estimated cost to airlines of $125.00 per firing, the device represents a small investment in the light of its safeguarding of passengers and aircraft against take-off crashes resulting from engine failure.

The originators of Jato also envision its application to light, private planes, particularly amphibious ones, at an expenditure of about $30.00.

With this auxiliary propulsion, the vacationing executive can return from his fishing grounds without first having to jettison most of his catch in order to lift his craft from the water, the speakers predicted.

* * *

More than 300 members enjoyed a pleasant Sunday outing on September 8 when the Chapter held its annual picnic at Valley Park Country Club. Sports, games, prizes and a barbecue dinner were featured.

The successful event was directed by Harold Miller, Entertainment Chairman.

Cellophane Bubbles Fill Mattress of Future

Peoria, Ill.—Samples of products of the future were displayed and explained by Dr. Hilton Ira Jones, chemist, and Director of Hizone Research Laboratories, Wilmette, September 17, at a meeting of Peoria Chapter in the Jefferson Hotel.

Chemists, Dr. Jones said, are making products of heretofore useless material. Among the modern discoveries and processes he described were plastic impregnated spun glass to make undentable automobile fenders; cheap glass dress material, "everlasting" and non-fading; flexible plumbing; and a spray solution to prevent runs in nylon hose and keep trousers from "bagging."

"We'll never eat another tough steak," he predicted in telling of a chemical that is sprinkled on meat before cooking, to insure tenderness. The speaker displayed a miniature ironing board cover of glass fabric that will not burn or tear, and said there will be a motor oil that will outlast a new car.

A razor blade made from a new steel being developed will last a lifetime without sharpening; a mold in breakfast food will give gloss to human hair; and a new glue will "stick anything" together, Dr. Jones forecast.

Also shown was "bubble fill," inflated cellophane which will be used in mattresses to make one feel as if he were "sleeping on air."

H. E. Conrad of Detroit, ASTE Executive Secretary, outlined the business and financial organization.

Weather Predictions Affect Industry

Rockford, Ill.—Gordon E. Dunn, Supervising Weather Forecaster for the North Central States, was guest speaker at the October 3 meeting of Rockford Chapter in Hotel Faust.

Mr. Dunn, who is associated with the U. S. Weather Bureau Service at Chicago Municipal Airport, stressed the importance of accurate weather predictions and how they vitally affect industrial and commercial activities.

His film, "Weather Theory," showed how cold and hot "air masses" are formed and how their movements enable the forecaster to predict storms or temperature changes. Another motion picture, "Thunder Storms," illustrated the formation and composition of thunder clouds.

The speaker closed his talk with a quip that people should remember that weather forecasters only predict the weather—they are not responsible for it.

During the war, Mr. Dunn served in the China-Burma-India theatre as a civilian consultant.

Moderate Cutting Speeds Extend Tool Life

Newark, N. J.—Metal removal techniques, employing carbide tools in milling operations, were explained in closest detail by Dr. Hans Ernst, Director of Research for the Cincinnati Milling Machine Co., at the opening session of Northern New Jersey Chapter at Hotel Robert Treat, September 10.

Dr. Hans Ernst

A pioneer in the use of carbides, Dr. Ernst gave an extremely informative talk, setting forth the many factors to be considered in the application of carbide milling. He demonstrated the action of positive and negative rakes and their effects on chip formation, rate of metal removal and finish obtained, showing numerous charts compiled from cutting tests.

The charts indicated clearly that optimum tool life is secured at relatively moderate cutting speeds, and that the super speeds frequently advocated are not usually suitable for economical production.

An outstanding feature of Dr. Ernst's talk was the presentation of a new motion picture, taken at the rate of 3000 frames per second, in which the motion was slowed to a point where chip formation and cutting action of the tools were clearly visible.

Current conditions made it necessary to discontinue the customary dinner, but the meeting was held as usual in the hotel ballroom, with about 150 members in attendance. The showing of an after-dinner film, long a feature of these meetings, took place before the official opening of the technical session, by request of the members.

Magneto Plant Shows Tooling, Research

Binghamton, N. Y. — Scintilla Magneto Div., Bendix Aviation Corp., Sidney, was host to Binghamton Chapter, September 4, for the tool engineers' first meeting of the fall season.

Approximately 100 members and guests had dinner in the plant cafeteria. Community singing, led by Past Chairman Roland Barratt, was highlighted with impromptu solos and duets by ASTE talent.

Following dinner, William Mazar, Chapter Chairman, introduced Walter Michel, Scintilla Factory Manager, who welcomed the Chapter. Mr. Michel briefly traced the history of the company from its beginning as a sales and service office established in New York City in 1921, to its present position as a leading producer of precision-built aircraft ignition equipment, Diesel injection products and numerous other allied items.

He also described the work done by Scintilla in meeting Army and Navy requirements for vital war equipment, concluding his talk with a resume of some of the company's plans for peacetime production.

The guests were then assembled in small groups for a tour through the plant. Members of the Scintilla supervisory staff conducted the parties, explaining in detail many of the specialized and highly technical operations necessary to maintain the required high quality of product.

Included in the tour were on-the-spot demonstrations of production tooling, testing and inspection methods.

Considerable time was spent in examining the research laboratory facilities where experiments are being conducted with electronic testing devices for use within the Scintilla organization. Frank Borchert, Scintilla Research Engineer, demonstrated some of the testing methods, one of which showed a magneto operating under water.

The visitors also inspected the stratosphere chamber where equipment is tested under various altitude and climatic conditions.

States Educational Aims

Hamilton, Ont. — O. W. Winter, National Education Chairman of ASTE, and Vice-President of Acme Pattern & Machine Co., Buffalo, N. Y., addressed 75 members of Hamilton Chapter at their meeting on September 12 in Fischer's Hotel.

Mr. Winter explained to the audience the educational aims of the Society to achieve proper recognition for the tool engineer. He cautioned that the future will be beset with many pitfalls; that much hard work is ahead before the tool engineer can take his rightful place in the sun.

A period of informal discussion followed Mr. Winter's talk.

Guests at the dinner meeting included C. H. Mitchell, Vice-President, Canadian Westinghouse Co.; D. O. Davis, Chief Engineer, Dominion Foundries & Steel; R. Taylor, Master Mechanic, Firestone Tire & Rubber Co.; and A. Fraser, Vice-President, National Steel Car Corp., all of Hamilton.

Light Wave Measurement Scientifically Accurate

San Francisco, Cal.—The tool engineer has brought about some of the greatest developments that industry enjoys today, Adam Gabriel, Vice-President, Acme Industrial Co., Chicago, Ill., told the 95 members and friends of Golden Gate Chapter attending the September 18 meeting in the Engineers Club.

Adam Gabriel

Mr. Gabriel, speaking on "Light Waves and Their Uses in Precision Shop Measurements," reviewed chronologically the development of standards of accuracy. He made plain the growing need for scientifically accurate standards of comparison in modern industry.

In the use of the light wave, he pointed out, there exists an unchanging length value, the application of which is fast becoming more generally understood by the tool engineer.

Explains Subject Simply

Presenting a complex subject in everyday shop language, the speaker described the varying wave band patterns occurring during the measurement of plane surfaces and the methods by which the amount of inaccuracy is determined.

Practical applications and methods of using light waves as a medium of measurement in industrial tooling and processes were explained, Mr. Gabriel illustrating the theory and mechanics involved in the application of light waves, through the medium of slides.

The speaker called attention to the use of light waves in inspecting parts incident to the manufacture of stuffing boxes for Navy submarines. Development of the technique improved the efficiency of the component and lowered its cost, he said.

Other applications related by the lecturer included the utilization of light wave interference fringes to compare the size of cylindrical and tapered members with that of known standards and to determine the inaccuracy of worn gage blocks and thread gages.

A particularly enthusiastic question period followed Mr. Gabriel's address, vividly indicating intense audience interest in his subject.

Second on the program, but of commanding interest, was a color film, "The Age of Precision," released by the Cincinnati Grinding Machine Co. The motion picture discussed in detail some of the exact machine operations and inspection tests entering into the manufacture of precision grinding machines.

Quotes Golden Rule As Industrial Policy

Boston, Mass.—Featured speaker for Boston Chapter's Past Chairmen's Night was Harry Coopland, Special Representative for Jack & Heintz, Inc., Cleveland, Ohio, who addressed the 160 members and guests attending the September 12 function at Schrafft's Restaurant.

Harry Coopland

Mr. Coopland's talk, "Seeing Is Believing," dealt with the practicability of the Golden Rule in business and industry. Emphasizing that the brotherhood of man is a real possibility in business, the speaker cited instance after instance of its application at the Jack & Heintz plants.

The audience was convulsed with laughter for many minutes at the beginning of Mr. Coopland's address as he related "just one more anecdote."

Chairman J. B. Savits, the presiding officer, introduced the guests of honor: Past Chairmen A. D. Forbes, 1940-41; C. A. Lockwood, 1941-42; J. W. Geddes, 1942-43; Warren Ames, 1943-44; Henry J. Richards, 1944-45; and Arthur A. Nichols, 1945-46.

"Much of the growth of ASTE has been due to the fact that, in addition to the Society's ability to help the individual, it has provided, also, a means by which the tool engineer could be of greater help to his own company," said Mr. Savits.

Edward J. Ovington, Consulting Engineer of Ovington's, Boston, was the gadget speaker, discussing "A Simple Method of Scale Removal from Heat Treated Steel."

Introducing a new "How-to-Do-It" feature, William Roderick, a Chapter member, served as commentator for a slide lecture on "Brazing Tungsten Carbide Tools."

Guests included visiting members from Milwaukee, Hartford, Pittsburgh, Worcester and Hudson, Mass.

Situation Wanted

SALES MANAGER—Fifteen years' experience marketing industrial specialty lubricants, related products and chemicals; nine years in the capacity of Industrial Sales Manager. Thoroughly familiar with lubricant compounding. Capable of getting results. Successful record training and directing efforts of associates. At liberty to go anywhere. Address Box 102, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Mich.

Head table guests join in the hearty community singing during Binghamton Chapter meeting at Scintilla Magneto Div., Bendix Aviation Corp., Sidney, N. Y. Plant Tour followed dinner.

A·S·T·E· Productioneers

YOUR CENTRAL OFFICE STAFF

NERVE CENTER of the ASTE office operation is the automatic, mechanical accounting system recently installed at the Society's Headquarters.

With this multi-operation machinery, the entire membership mailing list can be run off in 14 hours, dues billing can be accomplished in 17 hours, and membership accounts posted at the rate of 60 per minute.

Compared to the several days required to complete a general mailing with the former unpredictable addressing machine, and correspondingly long periods for accounting operations, this application of the mass production principle to office procedure represents a tremendous annual saving of man- and girl-hours, plus increased efficiency.

While no financial saving is effected in the use of the intricate, leased equipment, additional projects can be executed without increasing the staff.

* * *

All operations in the Accounting Department are carefully synchronized, each of the three members of this division co-operating in the development of the ultimate product—the monthly financial statements.

First step in integrating a new membership into the Society's accounting system is the cutting of a series of four key-punched cards on which all of the affiliate's subsequent Society history and account entries will be recorded.

With the electric key punch machine, Frances Gerken, the ASTE bookkeeper, can "induct" new members at the rate of 50 per hour, transferring the information contained in the membership application form.

All Transactions Key-Punched

All funds received by the Society pass through her hands. Payments received before two o'clock are deposited in the bank on the day of arrival. Every remittance, whether for dues, *Tool Engineer* advertising or other obligations, is punched on the master cards which are the basis of the streamlined accounting method.

Further processing of the cards by other members of the department enables Frances to post her ledger, compile the semi-monthly ballots for each Chapter, and the National financial statements.

Miss Gerken, who has become thoroughly familiar with this phase of the Society's operation during her three years in the department, also handles all of the Accounting correspondence.

Habitually calm and collected, Frances is temperamentally suited to her work. Off duty, her interests are distinctly musical and embrace singing in a girls' trio, in the Holy Cross Lutheran choir, and playing the piano.

Coming from her home town of Wauseon, Ohio, she began with ASTE in June of 1942, as a typist. She was graduated from the Malinta-Grelton High School, in Malinta, Ohio, has taken several courses at Detroit Business Institute, and attended the I.B.M. Customers School in Detroit.

* * *

Debits are the province of Frances Renners who writes all checks issued by the Society for supplies, expenses, salaries, travel, Chapter allocations, *Tool Engineer* and other transactions. As in the case of receipts, records of payments, too, are punched in the various account cards.

When the cancelled checks are returned from the bank, Miss Renners reconciles the bank statement, completing the disbursement operations.

Handles Income Tax Reports

She takes care of the staff's income tax accounts as well, including the preparation of annual statements for the employees, of amounts deducted from their salaries for tax purposes.

Frances, who was formerly associated with Michigan Bell Telephone Co., entered the employ of the Society two years ago as switchboard operator and file clerk.

Born in Hendersonville, Pa., she was educated at the Cecil High School, Venice, Pa., Detroit Business Institute, and the I.B.M. Customers School, Detroit.

Always in high spirits, Frances finds expression for some of her exuberance at the Arthur Murray Studios where she is studying to be an instructor in rhumba, conga and other ballroom steps. On the more serious side, she serves as a Nurse's Aid at Receiving Hospital.

* * *

Using the account cards which the Misses Gerken and Renners have punched, F. Russell McCrea can prepare rosters, address labels for *The Tool Engineer*, binders, emblems, data sheets and other mailings; dues notices and statements, envelopes, financial statements, coded mailing lists used for the distribution of publicity releases, and any other required data or statistics.

Operates at High Speed

The cards are first placed in the tabulating machine with its complicated control board set to pick up a given set of cards as, for instance, the membership of a specific Chapter. The wanted cards, having been sorted at the rate of 450 per minute, are next placed in the accounting machine where another plug board is adjusted for the involved coordination of the mechanical "brain."

With the completion of the listing or addressing operation, at a speed of from 80-150 entries per minute, the cards, along with those discarded by the tabulating machine, go to the collating ma-

Frances Renners (upper left), the life of the office, applies herself seriously to business of key punching account cards. Serene Frances Gerken checks ledger entries made on mechanical accounting machine from which F. Russell McCrea is removing another completed sheet. In addition to bookkeeping and listing operations, machine addresses envelopes for The Tool Engineer and other mailings.

With characteristic cheerfulness, Mary Iremesco endeavors to trace members whose mail has been returned from last-known address. Is your copy of the Code of Ethics in one of those tubes?

chine which returns them to their original order at from 50-150 per minute, according to the complexity of the operation.

"Russ," not only operates these three units of the accounting setup, but services them as well when they need adjustment.

Equipped with several years' experience in the tabulating and machine accounting field, Mr. McCrea came to ASTE in February from Micromatic Hone Corp., Detroit, where he was tabulating supervisor.

Studying for C.P.A.

He was born in Boyne City and had his high schooling in Caro, Mich. "Russ," who has attended the I.B.M. Customers School in Detroit and the I.B.M. Advanced Supervisory and Machine Accounting School at Endicott, N. Y., is now studying with the I.A.S. for his C.P.A. examination

Possessed of poise and a pleasing personality, Mr. McCrea is popular with his fellow workers. He dotes on his small son and daughter, enjoys "tinkering around the house," and manages a bit of pheasant hunting in the fall.

* * *

Closely related to the Accounting Department is the processing of address changes, handled by Mary Iremesco. Here, work reduction, through the introduction of the mechanical system, has been phenomenal.

Formerly, when a member notified the Society of a new address, the information had to be entered on the address plate, ledger card, and in the individual's file. With address changes often totaling 500-600 per month, this was a never-ending task. Now the only operation is the punching of a new set of cards for the master file.

In addition to keeping current the addresses of members who change their places of residence or employment, Mary also has the problem of locating "lost" members—those whose mail cannot be delivered because they have neglected to notify both the Society and the Postoffice Department of their new address.

Considerable ingenuity and sleuthing are sometimes required, through correspondence with former landladies, employers or relatives, in an endeavor to re-establish contact with such members.

When fourth-class mail is returned as undeliverable, a first-class tracer letter is sent out, with a return post card enclosed. If the letter is forwarded and the member located, the returned mail is sent to the new address and the member's account cards reinstated in the active file.

Tries to Maintain Services

Every effort is made to "find" these members so that they may not be deprived of the services to which they are entitled or, indeed, their very membership, through failure to receive dues notices and maintain their good standing.

Mary also enters changes in Chapter and other officers, issuing periodical bulletins to all Chapters, National Officers and Committees, listing such replacements or new addresses of officer personnel.

When a member moves to another city, Miss Iremesco suggests that he transfer to the Chapter in that vicinity. If he agrees to a new Chapter affiliation, this change is also entered.

Chapters are notified of changes of address or affiliation of their respective members, and their aid enlisted in securing current addresses of those whose whereabouts are unknown to the Central Office.

Simplification of her duties now enables Mary to assist other departments with typing, cutting mimeograph stencils, relieving at the switchboard and other assignments.

Before coming to the Society in the fall of 1944, Mary was employed at the Detroit office of the Fidelity and Casualty Insurance Co. of New York as a dictaphone and switchboard operator.

She is a graduate of the High School of Commerce Business School and attended LaSalle University Extension Stenotype College in the ASTE Headquarters city.

One of those seldom-discovered persons, a native Detroiter, Mary relaxes from her efforts in keeping pace with the peregrinations of ASTE'ers, by singing in the choir of St. George Church, participating in the activities of the George Lazar U.J.'s, a Romanian youth club; bowling, and such domestic occupations as cooking and sewing.

Bomber Autopilot Evolved From Thermostat

Detroit, Mich. — The mystery surrounding electronics was revealed to the 230 members and guests of Detroit Chapter who heard Gordon Volkenant, Co-ordinator of New Products Research for the Minneapolis-Honeywell Regulator Co., and speaker at a meeting September 12 in the Engineering Society of Detroit Headquarters.

Mr. Volkenant traced the development of the science from its origin 30 years ago in experiments with the tiny black particles formed by disintegration of the tungsten filaments in an incandescent lamp bulb.

Each particle of the blackening, Mr. Volkenant stated, is potent with a millionth of a fly power of energy capable of developing into one elephant power.

The minute specks or ions are charged with electricity, hence the term "electron," meaning a charged ion of metal.

Divulging the important but unpublicized part played by electronics in bombing operations, Mr. Volkenant described the electronic Autopilot developed from a thermostat.

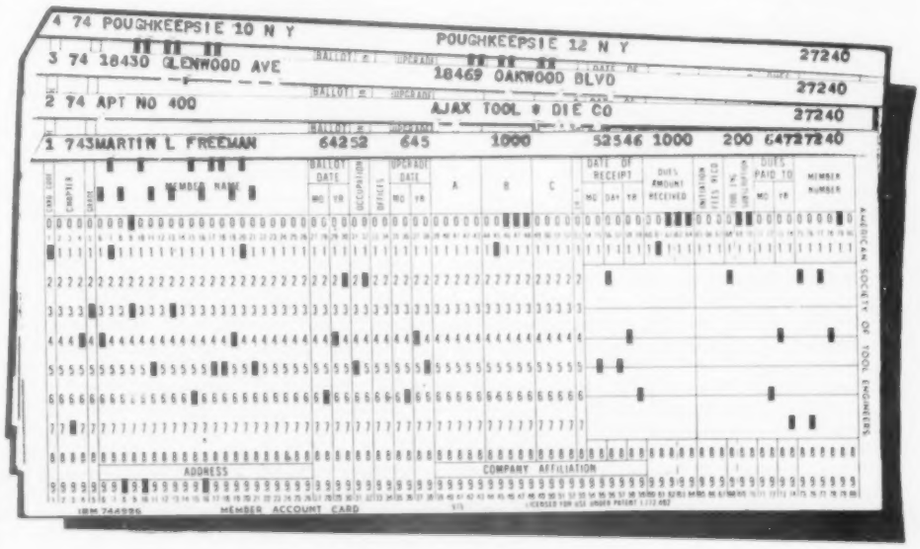
Saved Many Lives, Planes

Through its myriads of electronic circuits, the control device can make more than 300 flight corrections a minute, he said. Over 10,000 lives and 1000 airplanes were saved during the war by this instrument which safely guided the planes back to their bases after manual controls had been damaged or destroyed.

"Electronics" is merely another word for control, Mr. Volkenant summarized, indicating that modifications of the electronic weapons of war have wide peacetime applications.

During the dinner which preceded the technical session, the group was entertained with a recording of the "Quiz of Two Cities" broadcast made during the Annual Meeting at Cleveland and starring four Chapter members on the Detroit end of the program. Contestants who missed questions on the broadcast good naturedly accepted the ribbing of their fellow members.

After the gathering had adjourned to the E.S.D. Auditorium, a colored film of the summer golf party was shown, the audience cheering or heckling the players according to the action on the screen.



Cryptic punchings on a set of four cards record account and Society history of each ASTE member. Control boards of mechanical accounting system at the Detroit office can be set to pick up any given combination of punchings, translating them into bookkeeping and addressing data.

Seated at speakers' table for Atomic Power program presented September 13 by Cleveland Chapter are (left to right): H. E. Peiffer, Secy.; "Bill" Veeck, President, Cleveland Baseball Company; E. W. Baumgardner, 1st V. Chm.; Jerry De Groce, Supervisor of Consulting and Application Engineers, Westinghouse Electric Corp.; R. E. Harrold, Chm.; C. V. Briner, Immediate Past Pres., ASTE; H. B. Osborn, Jr., 2nd V. Chm.; J. H. Schron, Treas.; C. W. Scheihing, Past Chm.; and unidentified assistant to Mr. DeGroce. Below, principal speakers at Allerton Hotel meeting: Mr. Briner acknowledging Life Membership Certificate presented on behalf of the Society by Chm. Harrold; Mr. DeGroce explaining atomic energy; and Mr. Veeck giving coffee talk.

Explains Atomic Energy, New Power Source

Cleveland, Ohio—The secrets of atomic power were divulged to Cleveland Chapter members by Jerry DeGroce, Supervisor of Consulting and Application Engineers, Westinghouse Electric Corp., in a meeting September 13 at the Allerton Hotel.

In lay language, Mr. DeGroce outlined the basic nuclear physics that create atomic energy, pointing out its tremendous possibilities for good and evil. He predicted proposed peacetime applications of this source of power, quoting cost figures at which atomic energy becomes competitive with present fuels.

At the conclusion of his speech, the speaker answered many questions, giving information hitherto undisclosed because of wartime security regulations surrounding the great bomb project.

After the open discussion, Mr. DeGroce demonstrated, with a capsule of radium, the action of the Geiger counter, used to detect the presence of radioactive material.

Coffee speaker for the evening was "Bill" Veeck, President of the Cleveland Baseball Company, who entertained the group with his humorous sidelights on baseball.

Following the dinner, Chairman Rudy Harrold presented Immediate Past President C. V. Briner with the Life Membership Certificate awarded by the Society to retiring presidents.

Engineers Needed in Search for German Secrets

Washington, D. C. — Opportunity to visit Germany and uncover recent technical developments for use in American industry is afforded through the Technical Industrial Intelligence Division of the Department of Commerce in its appeal for trained engineers in its Automotive and Machinery Units.

Two classifications of investigators are still needed in the quest for new formulae, processes and products in various industrial and scientific fields.

In the Automotive Unit, several positions are open for technical screeners to be employed by the Government and sent to Germany for a minimum period of one year. Routine work is done by German civilians, but qualified American technicians are indispensable for the all-important job of supervision and selection.

Expense Allowance Provided

Salary ranges from approximately $4332.00—$5902.20 per year, depending upon training and experience. A small living allowance and transportation are also furnished. In addition to pecuniary emoluments and the service to American industry, the assignment offers an experience valuable to any engineer.

Investigators, to be sponsored by companies or scientific groups interested in securing information on German industrial methods, are needed in both the Automotive and Machinery Units. This work is carried on without compensation, and the information obtained must be made available to all industry.

American citizenship, a knowledge of technical German, and adequate qualifications in the selected field of activity are essential for appointment to the study of German technical documents and files.

Never before, the Commerce Department points out, has American industry had so great an opportunity to acquire information, based on years of painstaking research, quickly and at little cost. It is, however, important to secure immediately this portion of German reparations while the data is still accessible, the Department adds.

Further information, concerning the openings available, may be had from Lloyd R. Worden, Chief, Aeronautics and Automotive Unit, Technical Industrial Intelligence Div., Department of Commerce, Washington 25, D. C.

Compares Right and Wrong Twist Drill Practices

Fond du Lac, Wis. — Approximately 60 members and guests attended Fond du Lac Chapter's first fall meeting at the Elks Club in Kaukauna, on September 13.

One of the highlights of the meeting was the talk by Ralph J. Kraut, President of Giddings & Lewis Machine Tool Co., who gave a brief resume of his recent trip to Europe.

Keen interest was evident in the many questions asked Mr. Kraut during the subsequent open forum.

Technical speaker was E. T. Snider of Cleveland Twist Drill Co. Mr. Snider spoke on "Uses and Abuses of Twist Drills." Supplementing his lecture was a motion picture illustrating the proper methods of sharpening and using twist drills for maximum efficiency

At the conclusion of his talk, Mr. Snider conducted a lively discussion period.

Guests included visitors from Geneva, Switzerland; Cleveland, Ohio; Chicago, Ill., and Milwaukee.

Proper Initial Tooling Can Be Source of Economy

Elmira, N. Y.—Walter M. Smith, Eastern Sales Manager for Bryant Chucking Grinder Co., Springfield, Vt., addressed Elmira Chapter at a meeting in the Mark Twain Hotel on September 7.

W. M. Smith

Mr. Smith began his discussion of "Better Tooling" by briefly sketching the history of tools from the stone axe, a simple all purpose tool, to the present precise and often single purpose machine tools.

In the purchase of new or surplus machines or in re-tooling, Mr. Smith pointed out, it is wise to present the full problem to the machine tool builder so that he may recommend the proper machine equipped with adequate tools.

High frequency direct motor driven spindles, the speaker announced, are past the experimental stage and are being successfully applied to the drilling of small holes.

In the accompanying motion picture, of typical war production tooling, the engineers were particularly interested in the sequences showing a balanced indexing fixture holding an aircraft master connecting rod.

Among recent developments, described in the film, were form and contour grinding with cam-controlled dressing of single or double wheels, and the use of two spindle heads to square a shoulder with the bore without rechucking the work.

Samples of parts finished to less than one micro-inch on production type machines were exhibited.

Diamond Valuable High Speed Cutting Tool

St. Charles, Ill.—Diamond, its history, processing, and application to tool engineering was the subject presented to members of Fox River Valley Chapter at a dinner meeting, September 4, in Hotel Baker.

Jan Taeyaerts, President of Precision Diamond Tool Co., Elgin, was the guest speaker. He opened his discussion by explaining the need of deglamorizing the diamond as a gem in order to enhance its value to the tool engineer, as a useful tool in modern high speed technique.

Mechanical Progress Slow

Gem cutting, he said, began in 2000 B.C., but, until the beginning of the 20th century there were relatively few improvements in methods. In fact no mechanical assistance was given the gem cutter until 1476 when the cast iron, diamond dust impregnated polishing wheel, still used in facet polishing, was introduced to the profession. The next mechanical aid developed for the trade came in 1910 with the invention of the diamond saw. At present, some research is being conducted in the use of the electric arc in polishing, he observed.

The diamond itself, Mr. Taeyaerts pointed out, rather than a lack of ingenuity on the part of diamond craftsmen, has hindered advances in this field.

For purposes of analogy, he likened the granular structure of the diamond to the grain in wood. Diamonds may be cleaved only with their grain and sawed only across the grain. Similarly in grinding and polishing, the plane of the grain must be taken into consideration to produce long wearing industrial diamonds.

A comparison of the diamond to other known materials was made and some very interesting figures disclosed. As a metal cutting tool, the speaker continued, diamond depends primarily on physical hardness for its usefulness. The hardest mineral known, it is extremely brittle as compared to high speed tools.

Compares Cutting Materials

Because of its hardness, Mr. Taeyaerts stressed, the diamond is fast becoming a very valuable tool in the machining of plastic and abrasive materials. As an example of the relative speed with which non-ferrous materials may be worked, the speaker made the following comparisons for the precision turning of phosphor bronze: Cutting Speed—high speed steel, 130 fpm; carbide, 650 fpm; diamond, 1000 fpm. Length of Cut—high speed steel, 5 miles; carbide, 12.5 miles; diamond, 1250 miles.

Another point, emphasized by the speaker as instrumental in the introduction of diamond to thread turning tools, is that a tool with a relatively sharp point, .002″ to .005″ radius, is many times more durable than one with a larger radius in the proximity of .125″.

Romance of the diamond, its development, geographical sources, and difficulties encountered in obtaining it were well illustrated by a selection of slides followed by motion pictures of diamond mining in the South African fields.

Exploding popular fallacies, Mr. Taeyaerts informed the group that source location and color have no bearing on the diamond's physical properties. Volcanic in origin, the stone is found in many different surroundings. Its most common source is the pipes or blue holes of extinct volcanoes, but in the Belgian Congo diamonds are found by open pit mining at a depth of only ten feet.

While the African mines yield approximately 85% of the world's diamond supply, the quality of the stones found there is the poorest, approximately 80% being of inferior grade. Though fewer in quantity, diamonds found in Brazil are usually of high quality.

Closely related to diamonds are carbons, minute crystals of diamond structurally suspended in a comparatively spongy mass. These stones are not crystalline in structure and are extremely tough, resisting all efforts to cleave them.

Not lending themselves well to the machining of metals and being expensive because of their relative scarcity, carbons are used primarily in deep rock drills where resistance to abrasives is the main consideration and breakage from vibration and shock is not important, Mr. Taeyaerts concluded.

In the business meeting which preceded the technical session, the members approved the introduction of a "coffee hour" to follow the serving of dinner. During this period, two representatives of local industries will acquaint the group with their respective products and the part they play in the industrial advancement of the area.

Jan Taeyaerts, President of Precision Diamond Tool Co., tells Fox River Valley members how diamonds are mined, their applications in high speed metal cutting. In right background are: H. J. Braun, Chm.; B. J. Phillips, Treas.; and D. G. Bechtel, Membership Chm. At left of speaker (hand on knee) is R. G. Fragness, 2nd V. Chm. of the Chapter. Mr. Taeyaerts' address was technical feature of September 4 meeting in Hotel Baker, St. Charles, Ill.

Obituaries—

Laurence S. Andrich

Laurence (Larry) S. Andrich, Vice-President and General Manager of Snyder Tool and Engineering Co., Detroit, died in Henry Ford Hospital in that city, September 10, after a long illness.

L. S. Andrich

Mr. Andrich was born in Galt, Ont., in 1901 and joined Snyder in 1928 as a draftsman. He rose rapidly in the organization, holding many responsible positions. For a number of years he was Vice-President in Charge of Sales and Engineering. In that office he became known throughout the country as an authority on special machine tools and process engineering.

For the past year he had had the position he held at the time of his death. Previous to his association with Snyder, he was employed at Oakland Motor Car Co. and Dodge Bros. Corp., Detroit, as tool engineer.

A member of Detroit Chapter, ASTE, Mr. Andrich was also affiliated with Essex Golf and Country Club, Detroit Yacht Club, and Friendship Lodge No. 417, F. & A. M.

Cammille E. Monnier

Cammille E. Monnier, Secretary and Treasurer of the Eureka Tool & Die Co., Dayton, Ohio, died at his home there on August 4.

Born in France, Mr. Monnier had been a resident of Dayton for 31 years and had attained a prominent position in the community. Prior to establishing the Eureka company with George Capliski in 1919, he had worked with the Edison Co., Burroughs Adding Machine Co., Stenotype Co., International Money Machine Co., and the Dalton Adding Machine Co.

His wealth of experience made him an invaluable member of Dayton Chapter, ASTE, and his activity contributed greatly to the success of the local organization. He was an outstanding authority on the design and manufacture of tools and dies.

In addition to his work with ASTE, he was a member of the Dayton Engineers Club and ASM. He was also prominent in Masonic circles, having been affiliated with the Knights Templars and Scottish Rite, as well as several of the social organizations.

A group of Cleveland Chapter officers and their families pause for refreshments during annual outing September 15 at Richmond Country Club.

Here the engineers' wives compete for honors in sewing patches on seat of hubby's pants.

This scramble for pennies was one of the events on the program for kiddies of tool engineers.

Optical Comparators Have Manifold Inspection Uses

Cincinnati, Ohio—"Modern Methods of Inspection by Optical Projection," was the subject of a talk given by H. L. Murch before approximately 100 members and guests of Cincinnati Chapter at their October 8 meeting in the Engineering Society Headquarters.

Mr. Murch, Chief Optical Engineer of Jones & Lamson Machine Co., Springfield, Vt., outlined the principles of construction of J & L comparators, explained possible uses, and named a multitude of parts inspected by projection. He used a series of slides as illustration.

Prior to the technical session, a short, industrial sound film was shown. The production, "Working for Fun," depicted the manufacture of sporting goods by Crawford, MacGregor, Canby Co. of Cincinnati.

Charles Armstrong, a prominent Cincinnati attorney, spoke informally on "Smoke Abatement." He explained the aims of local civic organizations to have the Cincinnati City Council pass ordinances prohibiting the use of highly volatile fuels within the city limits, without proper smoke control devices.

Refreshments were served at the close of the dinner meeting.

As Bob Southwell reaches goal in shoe balancing race, Julius Straka takes off nonchalantly.

Families Entertained At Annual Picnic

Cleveland, Ohio—Cleveland tool engineers and their families had a day of fun and frolic at the Annual Chapter Picnic held September 15 at Richmond Country Club.

With the co-operation of the elements and the fine program arranged under the direction of Entertainment Chairman Jack Fitzsimmons, approximately 200 adults and more than 100 children enjoyed every minute of the Sunday outing.

Games, races, prizes and refreshments were featured for the kiddies. A horseshoe tournament, Bingo and soft ball games were among the events scheduled for the grownups. In the latter contest, the "Engineers" trounced the "Peddlers" 10-7.

Engineers Must Cut Costs To Offset Wage Increases

St. Catharines, Ont.—"A tool engineer must be a man of 'creative ingenuity'," said Otto W. Winter, Vice-President, Acme Pattern & Machine Co., Buffalo, N. Y., and National Education Chairman, ASTE, speaking at the first annual Ladies' Night of Niagara District Chapter held in the Welland House, September 20.

O. W. Winter

Describing the tool engineer as "a modest man," the speaker, who is a former President of the Society, observed that the tool engineer came to the fore during the war, finding his place among other engineering fields.

"The lawyer has extenuating circumstances, the doctor buries his mistakes, but the tool engineer has to live and make his mistakes work," he commented.

Mr. Winter declared that wage increases meant either raising prices or lowering manufacturing costs. The latter alternative, he pointed out, places the full burden on the tool engineer whose responsibility it is to produce the best tools for a given job at the lowest cost.

During the evening, Mrs. Winter, wife of the speaker, was presented with a St. Catharines-made rug on behalf of the Chapter.

A feature of the program was the entertainment put on by a group of singers, musicians and dancers.

Head table guests, in addition to the speaker, included Chairman E. G. Dewar, Past Chairman Henry Hendriks and Mrs. Hendriks, and National Assistant Secretary-Treasurer W. A. Dawson and Mrs. Dawson.

Jessop Speakers Present Tool Steel Symposium

Milwaukee, Wis.—A three-part technical program, concerning the manufacture, uses and common failures of tool steels under various conditions, featured the first fall meeting of Milwaukee Chapter, September 12, in the Elks Club.

First of the three speakers sponsored by the Jessop Steel Co. of Washington, Pa., was J. R. Harbaugh, Sales Metallurgist, High Speed and Tool Steels Div., who talked on "Common Failures of Tool Steel." His discussion dealt with the basic constituents used in the manufacture of tool steels, the machining of the metal, and failures of the finished parts, traceable either to faulty design or improper heat treatment.

Shows Diecasting

In conjunction with the lecture, slides were shown, giving a clear-cut visualization of the subject.

S. J. Clokey, Assistant Manager, Cast-to-Shape Div., followed Mr. Harbaugh with a film, "Cast-to-Shape Tool Steels." Mr. Clokey explained the former method of making vari-shaped and complicated dies from tool steel, citing the life of the standard tool steel die in comparison with dies made from sintered carbides.

He also indicated where considerable economy could be effected with dies cast to the required shapes. With the elimination of machining, only smoothing and polishing operations are necessary to obtain the finished die sets.

Final phase of the symposium was "Tungsten Sintered Carbides and Their Applications in Industry," presented by J. N. Peters, Manager, Carbide Div. His brief discussion of tungsten carbide tools preceded a sound film entitled, "Carbide Cutting Tools." The motion picture emphasized considerations in setting up work pieces so that proper feeds and spindle speeds can be combined to give the best results.

Butler Compares Metals For Cutting Tools

Chicago, Ill.—Relative importance, to the nation's industry, of high speed steels, cast non-ferrous cutting alloys and sintered carbides, was stressed by Dr. G. M. Butler, Associate Director of Research, Tool and Die Div., Allegheny Ludlum Steel Corp., in an address before more than 200 Chicago Chapter members and guests, October 7, at the Furniture Club of America.

Talking informatively on the proper use of various cutting tool materials, Dr. Butler emphasized the many types of tools still most economically made of high speed steels.

Other points covered by the speaker included applications best served by carbides and cast alloys; factors affecting choice of cutting material; and desirable characteristics of various high speeds steels, as well as the future of these metals.

In the showing of a highly descriptive slow motion picture, the members saw the actual mechanism of metal cutting on a miller, lathe and various other machines. Manufacture of laminated dies and their applications were also depicted in the film.

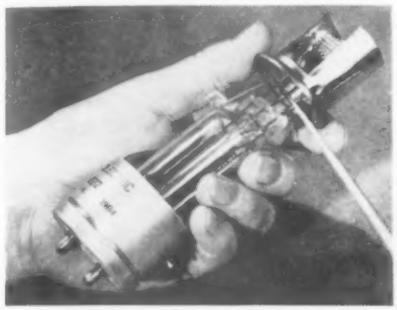
O. W. Winter, ASTE National Education Chairman, was a guest at the meeting and spoke briefly on the Society's educational program.

FILM FLASHES

This Is Resistance Welding is a new, 30-minute, 16mm, color-sound film designed to promote a still broader understanding of the operating principles and the many advantages of the more widely used types of resistance welding.

Products, ranging in size from the massive steel shell of a railroad coach to an electronic tube filament only one-thousandth of an inch thick, are shown being fabricated easily, quickly, efficiently and economically by resistance welding.

Following a colorful introduction in which a striking parallel is drawn between modern resistance welding technique and the primitive heat-and-pressure method of the village blacksmith of old, the motion picture opens with a detailed explanation of the general principles of resistance welding.



A tiny electronic tube filament, fabricated by the resistance welding process, is shown in the color-sound film, "This Is Resistance Welding."

Animated drawings and clear close-ups reveal how pieces of metal are held under continuous, correct pressure, between the electrodes of the welding machine while carefully timed, low-voltage, high-amperage direct or alternating current fuses them together.

Next are shown the four principal types of resistance welding—spot, seam, projection, and flash welding. Spot welding, the most extensively used, is shown as a technique by which fitted pieces of metal are joined together, fusing one spot at a time. In projection welding, the current is concentrated on a projection in the surface of the work itself, thus localizing the heat and determining the size and shape of the weld.

Seam welding is pictured as a method of applying current at regular intervals by water-cooled electrodes to make a series of automatically timed spot welds. Flash welding is demonstrated as a process of fusing two pieces of metal end to end.

Subsequent sequences disclose how quantity production is possible through the efficiency of modern resistance welding machines, with their accurate pressure control, low inertia of moving parts, versatility, high speed, and low maintenance.

The basic operation of synchronous electronic control equipment, bringing new standards of precision to the regulation of welding current, is then described. Resistance of work material to the current, magnitude and timing of the current are all explained in a series of interesting closeups and animated diagrams.

Available through electric utilities, welder manufacturers, and General Electric Company offices throughout the country, the film may be borrowed for exhibition before interested groups.

These Rochester Chapter members study samples illustrated in slides accompanying lecture, "Presses Geared for Automatic Production," delivered by H. F. Zorn of the V & O Press Co., at September meeting. Mr. Zorn (third from left around the table) discusses one of the demonstration parts, while Chairman Charles Seely (at end of table) examines another.

Automatic Presses Speed Peacetime Production

Rochester, N. Y.—Speaking before the September 11 meeting of Rochester Chapter in Rochester Institute of Technology, Herman F. Zorn, President of the V & O Press Co., Hudson, N. Y., discussed "Presses Geared for Automatic Production."

H. F. Zorn

With the aid of slides, Mr. Zorn described many applications of presses adapted to the automatic production of 30- and 50-caliber cartridge cases, primers and jacketed bullets, as well as the insertion of primer caps into cartridge cases, and the end trimming of shell cases as thick as .260", on rotary slitting machines designed for that particular purpose.

Peacetime applications explained by the speaker included the automatic production of parts for refrigerators, electric motors and generators. The presses were shown equipped with rotary indexing tables, slides and linkage to move the parts in proper sequence for each operation.

Speeds of from 50 to 1500 hundred strokes per minute on presses used in zipper manufacture were reported by Mr. Zorn.

Following the talk, he showed a motion picture of scenes in and around the V & O factory.

Standards Comm. Plans New Series of Data Sheets

Detroit, Mich.—At a recent meeting of the National Standards Committee, attended by W. B. Peirce, First Vice-President; W. B. McClellan, National Editorial Chairman; and H. E. Conrad, Executive Secretary, it was decided to publish Engineering Information Data Sheets through the Committee's own channels rather than in *The Tool Engineer* as previously scheduled.

Among other advantages, the new arrangement will enable the Society to present this information to members upon their affiliation with the organization; readers will not be obliged to mutilate their copies of the ASTE magazine; and the sheets can more readily conform with the standard physical format for punching and paper stock.

It is the plan of the National Standards Committee to include a complete set of Engineering Information sheets on "Twist Drills" in the next mailing of product data sheets.

The Committee will invite manufacturers in other fields to contribute similar information in order that a continuous flow of this type of data may be issued to the membership.

Chapters

Put the ASTE News Editor on your mailing list for meeting notices and season programs. Send c/o The Tool Engineer, 1922 W. Canfield, Detroit 8, Mich.

Handbook Important Medium in Establishing Scope of Profession

SOME THINGS an engineering student is required to buy—textbooks, drafting set, laboratory equipment, and so on. Some things he doesn't have to buy, but wants very much, such as an emblazoned sweater, a frat bid, or a little black book of phone numbers.

There's one other thing, not on the required list, he'll want enough to squeeze the allowance for—a handbook. Remember the proud day you bought your first handbook on the specialty you had decided to follow? Nobody made you do it, and it gave you that certain "professional" feeling.

To help instill that professional feeling into future tool engineering students, will be just one accomplishment of the "Tool Engineers' Handbook" — but a mighty important one.

In its educational activities, ASTE is going vigorously and intelligently about the dual job of establishing the professional scope of tool engineering, and getting tool engineering curricula set up and in motion.

Definite Profession

In its Handbook planning, the Society will confirm its educational policy by producing a manual which, by its very title and contents, tells the engineering student that tool engineering is indeed a definite profession.

Typical of the approval of educators, based only upon an outline of a handbook not yet published, is this comment by the head of a leading engineering school:

"We have been watching with interest your progress in bringing out the 'Tool Engineers' Handbook.' The tremendous field to be covered and the dearth of information on many of the subjects impresses us with the proportions of your undertaking. This handbook could readily be used in our tool design course."

The enthusiasm of editorial contributors to the Handbook, too, reflects an appreciation of the value of engineering educational facilities, as **Joseph Manuele**, Director of Quality Control, Westinghouse Electric Corp., East Pittsburgh, Pa., testifies:

"The biggest kick I ever got out of life was when I was notified by Massachusetts Institute of Technology that I had been accepted as a member of the freshman class."

This hard-won achievement culminated his efforts to enter an institution of higher learning via self-instruction in high school subjects while working in industry.

Gives Up Good Position to Study

Securing a high school diploma by special examination at Valparaiso University in Indiana, he passed his college entrance board examinations, and resigned his $75 a week position with the Atlas Crucible Steel Co. at Dunkirk, N. Y., to begin his formal technical training.

Graduated in 1925 from M.I.T. with a B.S. in E.E., Mr. Manuele joined Westinghouse to engage in inspection work, a field in which he already had some experience.

He began as an inspector of railway equipment, then gained further knowledge inspecting radio apparatus, power induction regulators, network protectors, and switchboards. In 1930 he was assigned to the Headquarters Inspection Office, becoming Director of Quality Control ten years later.

While he has contributed a number of articles to leading trade papers, Mr. Manuele particularly enjoys spreading the gospel of quality control through personal appearances.

Technical organizations before whom he has lectured include local and national bodies of engineers.

Mr. Manuele addressed the Annual Meeting of ASTE at Cleveland last April. His paper, "A New Approach—Statistical Quality Control," was included in the "Economic Control of Quality" symposium published in the August *Tool Engineer*.

Earle Buckingham

Joseph Manuele

For more than a score of years, **Earle Buckingham**, widely known as an authority on machine manufacture, measurements and gears, has devoted himself to engineering education, as Professor of Mechanical Engineering at the Massachusetts Institute of Technology at Cambridge.

His previous extensive experience in various branches of industry gives him a practical viewpoint valuable to students.

Inspected War Materiel

In the early days of World War I, Professor Buckingham, a graduate of the United States Naval Academy, inspected Russian munitions for the Canadian Car and Foundry Co.; was associated with the Eddystone Ammunition Co. as Chief Inspector of Sub-Contracts on Fuses; and held the posts of Equipment Engineer and Inspector of Tools at the Winchester Repeating Arms Co.

With the United States' entry into the first world conflict, he served as a major in the Ordnance Department from 1917-1919, his chief duty being the inspection of cannon.

Subsequently he was engaged for several months in designing a new reinforced concrete factory for the Veeder Manufacturing Co. For the 12 years prior to 1933, Professor Buckingham was a representative on the National Screw Thread Commission, established by Congress to standardize symbols, methods and other manufacturing practices. During this time he also acted as consulting engineer for Niles-Bement-Pond Co. and Pratt & Whitney.

A member of the sectional committee on standardization of plain gauges, screw threads and gears of the ASA, he is also affiliated with SAE and ASME. In the latter organization, he chairmans the special research commission on worm gears, is secretary of the special commission on lubrication, and acting chairman of the special commission on the strength of gears. In 1944, he was awarded the ASME Worcester Reed Warner Medal.

One of his technical works, "Principles of Interchangeable Manufacturing," is used as a text at the Institute. Other volumes which he has had published include "Involute Spur Gears," "Spur Gears," and "Dynamic Loads on Gear Teeth."

* * *

Education through industry is the field of endeavor in which **Harold G. Vogt** is engaged as Physicist in the Public Relations Department of Corning Glass Works, Corning, N. Y.

Having spent five years in physics research at the company laboratory, he now devotes his efforts to technical writing and lecturing on glass.

Did Research at Harvard

His work at Corning was preceded by graduate study and research at Harvard University where he was an instructor in physics for two years. During his stay at Harvard, he prepared publications on high voltage x-ray spectroscopy and on isotope separation.

Mr. Vogt is a member of the American Physical Society, the American Ceramic Society, and a fellow of the American Association for the Advancement of Science.

* * *

Ralph A. Wagner, Assistant Chief Tool Engineer at the Nashville Division of Consolidated Vultee Aircraft Corp., began his industrial career in 1916 as a mechanical draftsman.

A growing interest in method of manufacture and design of tools led to employment as a tool designer with various stamping companies.

H. G. Vogt

R. A. Wagner

In 1926, he joined Truscon Steel Co., Cleveland, Ohio, as Chief Draftsman, subsequently being appointed Assistant Chief Engineer.

At Cleveland much of his leisure time was spent instructing evening students in Die Design and Tool Design at the Cleveland Trade School.

Four years ago he became associated with Consolidated Vultee as Chief Tool Designer at the San Diego headquarters. He also served in his present capacity at the West Coast plant before his transfer to Nashville in 1945.

In addition to his war production responsibilities at the aircraft concern, Mr. Wagner wrote a chapter for the Design of Metal Stampings in the "Handbook of Designing for Quantity Production."

His lecture on Tool Design for Economic Manufacture, written for the University of California, was published in their Engineering-Science-Management War Training Program.

Coming MEETINGS

AKRON—November 14. Speaker: J. C. Wilson, Chief Engineer and Sales Manager, Thompson Grinder Co., Springfield, Ohio. Subject: "Crush Form Grinding."

BOSTON — December 12, 6:30 P.M., Schrafft's Restaurant. Speakers: Charles R. Staub, Chief Engineer, Michigan Tool Co., Detroit, Mich.; and John C. Dixon, Equipment Engineer, Pratt & Whitney, Div. Niles-Bement-Pond Co., West Hartford, Conn. Subject: "Symposium on Gears."

CEDAR RAPIDS—December 18, Annual Christmas Party, Montrose Hotel. Dinner 6:30 P.M., Program 8:00 P.M.

CENTRAL PENNA.—December 10, 7:15 P.M., West York Inn, York, Pa. Speaker: Charles O. Herb, Managing Editor, *Machinery*, New York City. Subject: "Unusual Things an Editor Sees."

CHICAGO—December 2. Speaker: George Sanborn, Chief Field Engineer, Fellows Gear Shaper Co., Springfield, Vt. Subject: "The Art of Generating and Gear Manufacturing Equipment." Display of samples and plastic models.

CINCINNATI—December 10, 5:30 P.M., (leave Cincinnati). Dinner, Manchester Hotel. Plant Visitation, American Rolling Mill Co., Middletown, Ohio.

CLEVELAND — December 14, Christmas Party, Hotel Carter.

COLUMBUS — November 13, Colonnade Room, Fort Hayes Hotel. Speaker: K. N. Macomber, Chief Service Engineer, Lapointe Machine Tool Co., Hudson, Mass. Subject: "Broaching."

DAYTON — December, Annual Ladies' Night. Time and place to be announced. Dinner, dancing, entertainment.

DECATUR—December 6. Speaker: George Sanborn, Fellows Gear Shaper Co., Springfield, Vt.

DETROIT—November 14, 6:30 P.M., Engineering Society of Detroit. Speaker: A. E. Rylander, Technical Editor, *The Tool Engineer*, Detroit, Mich. Subject: "Welding Fixtures for Mass Production."

ELMIRA—December 2, 7:00 P.M., Mark Twain Hotel. Speaker: Stanley Horosco, Vice-President, Republic Drill and Tool Co., Chicago, Ill. Subject: "Manufacturing of Shankless Drills."

FLINT—November 21, 6:30 P.M., General Motors Institute. Speaker: Mr. Leavenworth, Technical Representative, Dow Corning Corp., Midland, Mich. Subject: "Silicones as New Engineering Materials."

FOX RIVER VALLEY—December 3, Ladies Night.

GOLDEN GATE—November 20. Speaker: Robert J. DeRoche, Carborundum Co., Los Angeles, Calif. Subject: "Crush Grinding."

HAMILTON—December 13, Royal Hotel. Speaker: Donald Thorburn, Manager, Brantford Engineering & Equipment Co., Brantford, Ont. Subject: "Fundamentals Governing Selection of Furnaces and Fuel."

INDIANAPOLIS — December 5, Ladies Night. Travertine Room, Lincoln Hotel. Speaker: Wayne Guthrie, City Editor, *Indianapolis News*. Subject: "Ringside at Bikini."

LITTLE RHODY — November 20, Oates Tavern. Plastics Session. Speaker: C. E. Sundstrom. December 18, Christmas Party and Fun Night.

LOUISVILLE — December 10. Speaker: Harry Coopland, Jack & Heintz, Inc., Cleveland, Ohio.

MILWAUKEE—November 14. Speaker: William K. Andrews, Engineering Sales Manager, Kearney & Trecker Corp., Milwaukee, Wis. Subject: "Common Sense in Tool Design."

MUNCIE — December 11, 6:30 P.M. Speaker: Harry Coopland, Special Representative, Jack & Heintz, Inc., Cleveland, Ohio. Subject: "Seeing Is Believing."

PHILADELPHIA — November 21, Budd Night. Speakers: E. G. Budd, Sr., President, and John Whitesell, Chief Project Engineer, Edward G. Budd Mfg. Co., Philadelphia, Pa. Subject: "Tooling for Fabrication of Stainless Steel." December 19, Christmas Party.

PORTLAND (ORE.)—December 6, Christmas Party, Congress Hotel.

ST. LOUIS—December 5, 6:30 P.M., Melbourne Hotel. Speaker: Douglas B. Martin, Sales Manager, Amplex Div., Chrysler Corp., Detroit, Mich. Subject: "Powder Metallurgy."

TOLEDO — November 13, Toledo Yacht Club. Speaker from Denison Engineering Co., Columbus, Ohio. Subject: "Hydraulic Presses in Industry." December 9, 7:00 P.M. Speakers: Lowell H. Milligan, Assistant Director of Research, and Herbert S. Indge, Lapping Development Engineer, Norton Co., Worcester, Mass. Subject: "Surface Finishes and How to Obtain Them."

WILLIAMSPORT — November 11, 7:00 P.M., Williamsport High School. Ladies Night. Speaker: Dr. Hilton Ira Jones, Hizone Research Laboratories, Wilmette, Ill. Subject: "Peeps at Things to Come."

Intricate Shapes Formed With Lathe Attachment

Evansville, Ind.—Guest speaker at the September 9 meeting of Evansville Chapter was Frank Heap, Representative of the Monarch Machine Tool Co., Sidney, Ohio.

Mr. Heap lectured on the construction and operation of the Monarch Shapemaster Lathe, illustrating his subject with motion pictures. The lathe was shown in operation with a Keller profiling attachment for the generation of irregular shapes, making molds for glass or plastic ash trays and bottles of intricate design and form.

Announcement of the promotion of several Chapter members to new positions in their respective companies included: William C. Lauer, First Vice-President, Schnacke Mfg. Corp.; Walter Haag, Director of Safety, and Arthur A. Ullman, Asst. Superintendent of the Process Div., Servel, Inc.; Cecil Griffith, Chief Process Engineer, Hoosier Cardinal Corp.; and Herman Muehlbauer, Superintendent, Machine Div., Seeger-Sunbeam Corp.

Animated Open Discussion Follows Carbide Die Talk

Baltimore, Md. — Sixty members and guests of Baltimore Chapter turned out for the opening meeting of the season, September 4, at the Engineers Club.

M. J. Judkins

Malcolm J. Judkins, Chief Engineer of the Carbide Tool Div., Firth-Sterling Steel Co., McKeesport, Pa., was the speaker of the evening, using as his subject "Carbide Dies and Cutting Tools."

Various aspects of the manufacture of carbide dies and inserts were depicted in a motion picture narrated by Mr. Judkins.

A lively and prolonged question and answer period followed the formal discussion.

Program Personalities

Arthur A. Cambria, familiar to ASTE Chapters through his lectures on Broaching, has prepared an entirely new talk, "Modern Broaching."

A. A. Cambria

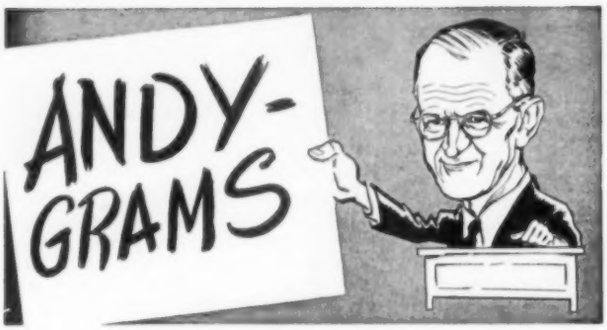
Mr. Cambria, who is now District Manager at the New England Engineering and Sales Office of the U. S. Broach Co., Detroit, has covered in his latest paper: the history of broaching, manufacture and maintenance of broaches, including sharpening; fixture design, and problems and equipment.

At the conclusion of the talk he will conduct a question and answer period. He is prepared to give advice on broaching problems, and invites all interested persons to submit prints so that he can determine whether the work should be done by broaching and how costs would compare with other methods.

Mr. Cambria is available to present this lecture to all New England Chapters and possibly to others, if demand is sufficient to develop an itinerary.

The speaker, who is a graduate engineer of Massachusetts Institute of Technology, served in the Air Corps in World War I, and was employed by the government until 1937 when he became Chief Engineer at the LaPointe Machine Tool Co., Hudson, Mass. He held this position until April of this year when he joined the U. S. Broach Co. He is a member of Worcester Chapter, ASTE.

Requests for Mr. Cambria's presentation may be made to him at the New England Engineering and Sales Office, U. S. Broach Co., Shrewsbury, Mass.



"GIVE ME A LEVER long enough," said Archimedes, "and I'll move the earth." Like a lot of old timers with ideas, the trouble with Archie was that he was born too soon—that is, before the age of tool engineering. F'rinstance, two Peoria concerns—Caterpillar Tractor and R. G. LeTourneau—are now moving the earth with tools that transcend the wildest dreams of the Athenian gadgeteer. But that's getting ahead of my story.

In response to invitation, I trekked Peoriaward in October, there to coffee-talk on whatever topic might pop to mind at the last moment. Fortunately, something did, going to show that there's no use crossing bridges 'til you get to the river. At that, I had an interesting trip—as usual. Ambling around Chi, between trains, stopped to watch the traffic officer at LaSalle and Van Buren do a job of directing that, in my opinion, qualifies him for a diplomatic post.

A "hello" and the time o' day with King Cole, over the phone, then a circling of city blocks hoping for something novel to turn up—like a ham or T-bone steak. But no, the Chicagoites were queueing (helluva word to spell!) around for chicken gizzards just like we do in Detroit. At LaSalle St. Station, bumped into *Vickers'* Rudolph Esch, also Peoria bound for a talk on hydraulics. Rudy is so thoroughly steeped in that subject that I strongly suspect that he was weaned on hydraulic fluid.

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Arrived at Peoria, was met by Ben Hartsock, Chapter Ch'man, who showed me the town and took me for a tour through and around Caterpillar Tractor. Lot o' territory covered by that outfit, with acres and acres of new construction under way. When I'd seen all that I quit worrying about the stock market. A visit with Supervisor Carl Holmer, who seems to wear as well with his associates at Caterpillar as he does with his fellows in the A.S.T.E. The boys in Peoria are doing a nice job of tooling.

Out to George D. Sills' home, in Peoria Heights, to view his array of guns. (As a collector, I'm just a piker.) First thing I saw was a Flobert cadet rifle which brought back fond memories. Wanted to buy it, but hated to ask lest I violate hospitality; then, when he offered it, I couldn't get my billfold out fast enough. Incidentally, George is an A-1 tool engineer and should be an A.S.T.E. member. I'll be right proud to have my name on his application. Come on in, George!

At night, the meeting, when I took my twenty minutes, more or less, then left it to Rudy Esch to serve the heavier fare. He did right well! Missed Gene Bertschi, who was out of town, but renewed acquaintance with Jim Knight and generally got to know my fellow tool engineers in Peoria. A fine group of men and very much on the ball as far as tool engineering is concerned.

What particularly impressed me is the way the two main industries of the town—Caterpillar and LeTourneau—support and encourage the local Chapter. In this connection I can truly say that any concern, big or small, that so encourages the tool engineers draws an excellent return on the time invested. Oftentimes just one idea, gleaned at a local meeting or at a convention—or even through casual conversation with a fellow member—may net savings far beyond immediate estimate. Industry and the tool engineers must work together, as one body, for national progress.

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Back in Detroit, to learn that the Pittsburgh convention had been called off a/c strikes. As aforesaid, I'm not supposed to have any opinions on these things, but, paraphrasing Anthony's oration over Caesar: "Friends, Romans, countrymen, lend me your ears. I'm just a poor dumb guy, inarticulate and all that. But if I were Brutus, and Brutus I, then, my hearties, I'd hand you a spiel that would make the very stones of Rome cry out in mutiny!" As it is, nobody seems to be doing a d——d thing about it outside of putting the blame on everything but the one thing needed to straighten it out. And that's production.

Never, in all the history of this nation, have we been faced with such a demand for consumer goods. The whole world is calling on us for the products of farm and forest, mine, mill and factory. There is work enough to keep every employable breadwinner busy, for years to come, at wages that will not only net a decent living but should net savings as well. In proof, I submit that wages have not dropped since the war, during which workers not only banked money but invested in war bonds as well.

The reserves, thus accumulated, were sufficient to bridge the reconversion gap—which, incidentally, was surprisingly short thanks to advanced tool engineering and technological progress in general. Supplemented with wages accruing from employment, this reserve meant purchasing power and national prosperity. But, the reserves are being dissipated in idleness the while a nation stands in queues all but begging for the necessities of life. There's the picture, factually presented. Nothing controversial about that.

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There's only one way out. Somehow, there must be impressed on the people of this land that there is only one road to prosperity, and that is through work. Through production! We must produce, or our national structure will crumble and disintegrate under our feet. And, it stands to reason that the small body of those who seem willing to work—who invent and design consumer goods and the Tools of Today that produce them—is not adequate to carry on its shoulders the legions now idle. The production of goods is a job for all!

It would seem, then, that we, the Tool Engineers have a mission entirely beyond our stint of tooling the nation. We must also assume the role of being our "brothers' keepers"; we must propagate the gospel of **WORK!** Of production! Let production—and the fruits of production—be a theme of meetings and group conversation. Spread it through the press—the daily newspapers, the radio and national magazines! Sell the idea of production to the men on the street, to your neighbors and the men in the shops, and enroll them in a holy crusade for production. For America, one slogan to be indelibly impressed on the public consciousness: —"WORK AND PRODUCE!" It's either that, or we degenerate into a nation of dependents.

Yours ASTEely,

Andy

Drilling and Boring Tools

Installment No. 4 of a Series

IN THE PREVIOUS installment, we discussed various types of drills, and the uses to which they were applied. We will now discuss the grinding of drills, a highly important phase of drilling since even the best of tools are of little use without the correct cutting angles.

In the diagrams below are shown various cutting angles for different materials. While these angles may be varied somewhat, the angles shown have been proven, in practice, over a considerable period of time. Reading down, left hand column, we have drills ground for mild steel, cast iron, hard rubber and aluminum, and brass. Also reading down, right hand column, we have drills for alloy steel, copper, and magnesium. These will be referred to, below, as cases 1, 2, 3, 4, 5 and 6.

Case 1. The included point angle is 118°, and the lip clearance 12° 15'.* It should be noted that stock drills, as furnished by the makers, are almost invariably made with 118° included point angle, or 59° on the side, and with about 7° lip clearance angle. These angles have been considered best to equalize thrust and torsion.

**See Fig. 3, Installment No. 1, August,* The Tool Engineer, *for terminologies of angles applied to drills.*

Case 2. While the included point angle shown is 118°—or standard—this may be decreased to 90°, with lip clearance (or relief) 12°.

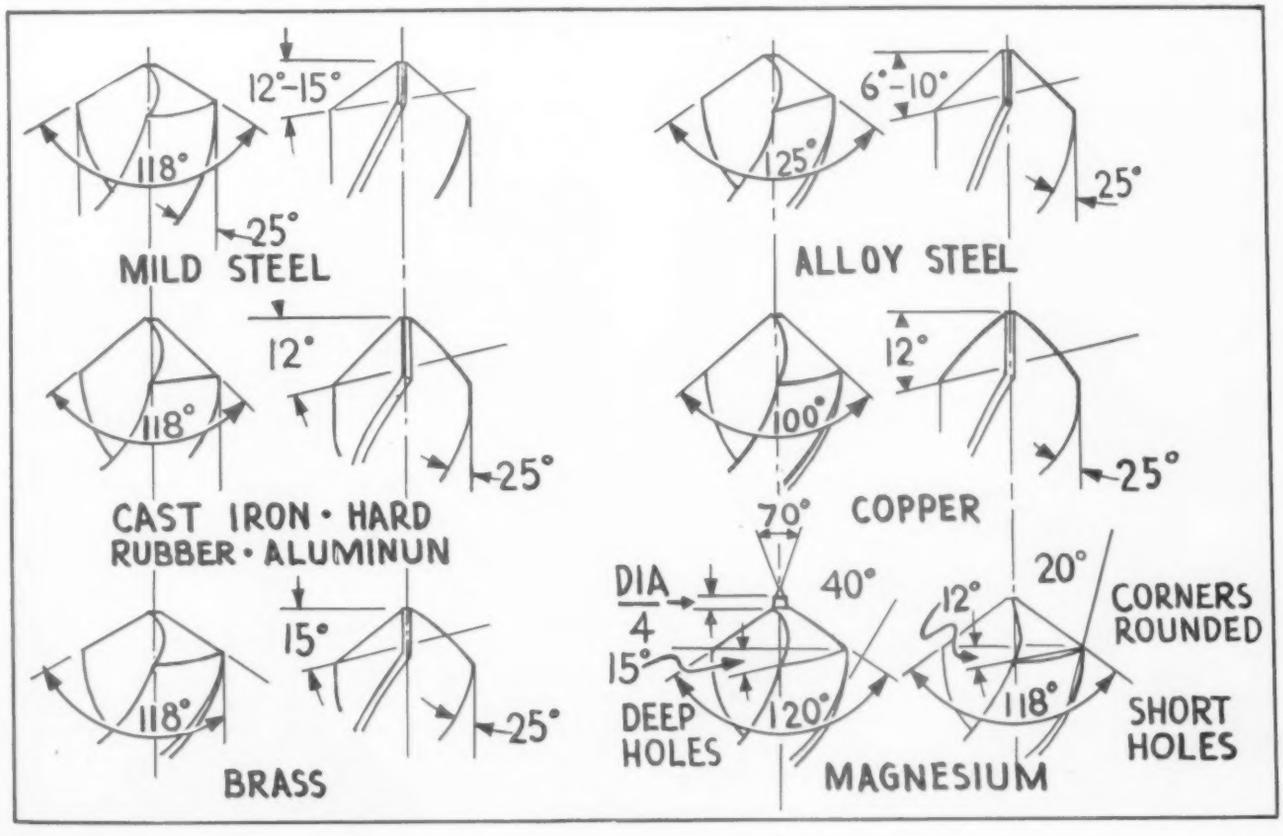
Case 3. Again, included point angle is standard, with relief angle 15°.

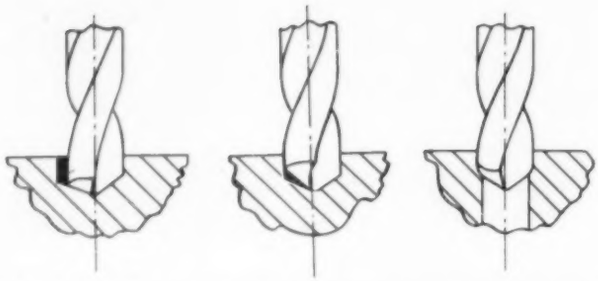
Case 4. Point angle is 125°, and relief angle 6° 10'.

Case 5. Point angle is 100°, and relief angle 12°.

Case 6. Here, two types of grinding are shown, the one at left for deep hole drilling, the one at right for short or shallow holes. Note that the first has a starting point, similar to that of a combination drill and center reamer, and that the point angle of the starter is considerably less—only 70°—than that of the large diameter, which is 120°. Relief angle is 15°. Note, however, the greater helix angle—40°—as compared to the lesser angle—20°—of the drill for shallow holes, which has 12° relief angle and standard point angles. Note also the rounded corners.

There are reasons for the different angles shown. For example, pressure required for feeding a drill through a material decreases in proportion to decrease in point angle. Thus, a drill with 90° included angle will require considerably less pressure, for feed, than one with the standard 118° angle. However, the lesser angle presents more surface to





Left, above, drill ground off center cuts oversize. Center, drill ground on center but with unequal angles cuts with one lip only. Right, drill with cutting edges rounded off serves as reamer.

the work, with the result that more power is required to turn the drill.

As regards the lip clearance or relief angle, the steeper this angle is, the more chance of the cutting edge chipping or breaking; inversely, too little lip clearance will create friction and rubbing, with consequent burning of the drill point. In the case of starting drills, the point angle should be about 100°, so that when the follower drill—which would have standard 118° angle—starts to cut, it will cut on the edges of the hole and not on the point, which would not only negate the advantage of the starter but might cause run-out as well. For example, the starter of a combination drill and center reamer has a lesser angle than the 120° included angle of the reamer. In this case, however, the difference in angle is not so important since the tool is made in one piece.

In grinding drills, it is extremely important that the cutting lips be ground exactly alike from the center outward. If, for example, there should be a variation in angles, then the greater angle will do all the cutting. Thus, if a drill is ground with one lip 60°, and the other 59° or less, the 60° lip will cut metal while the other merely cuts wind.

It is equally important that the drill be ground central. For, even though both angles be the same, if the drill is ground off center it will cut large—as much as twice the distance of the offset. There are times, however—as in cases of emergency—when such off center grinding is deliberately resorted to, so as to drill an oversize hole. The practice is not recommended. Lacking a chucking reamer, one may also round off the corners of a drill, when it can be used to size a hole previously drilled. The rounded corners leave a fairly smooth hole, as in the case of the off-center grinding; however, the practice is not recommended.

While drills should never be ground freehand, for mass production, since even the most highly skilled mechanic cannot consistently duplicate angles and clearances, a few pointers on freehand drilling may be in order. Especially so, since so few shop men, even if experienced in the use of drills, know how to grind them, and also because so many small shops—and this is especially true of home work or experimental shops—lack the equipment for machine grinding.

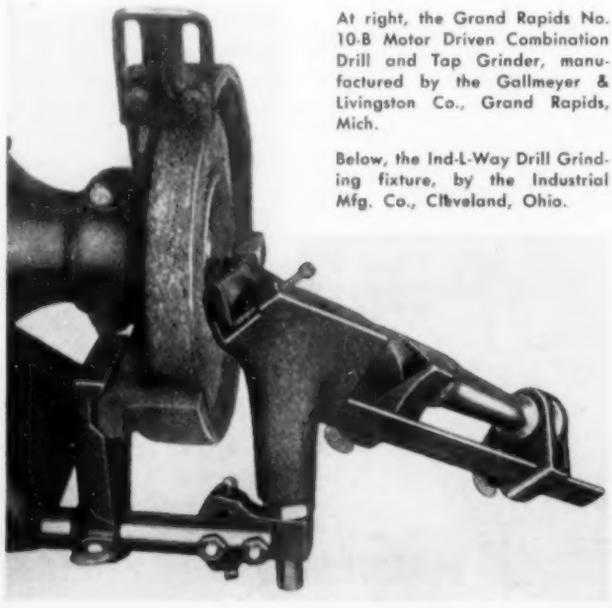
Care should be taken to present the same angle to the grinding wheel at all times. The knack can be acquired through practice. Then, grind with a rolling sweep, with the shank of the drill describing a downward, sweeping roll, which will effect the lip clearance or relief. By carefully watching the web, so that grinding is central and without rounding off the web center, a fairly good job may be done. While freehand grinding is not recommended, for reasons stated above, the "know-how" won't hurt.

The recommended method, of drill grinding, is with attachments or machines especially designed for the purpose. The principle is about the same in either case; that is, the drill is located in a Vee guide, or trough, with feed effected by means of a knurled hand knob. A swivel mounting provides for the roll.

Shown below, at right, is a modern machine for drill grinding, manufactured by the Gallmeyer & Livingston Co., Grand Rapids, Michigan. This machine is highly specialized and serves for tap grinding and general toolroom uses as well. At left, below, is shown the Ind-L-Way Drill Grinding Fixture, manufactured by the Industrial Mfg. Co., Cleveland, Ohio.

Fixtures of this type, which have been in use many years, may be attached to floor or bench grinders, and while not so versatile as the special purpose machine described above, or so exactly suited to mass production grinding, they will nevertheless permit drill grinding to exact requirements and at a very satisfactory output rate. With such tools available, there is no excuse for faulty grinding of drills.

End of Part 4. Installment No. 5, this series, will follow in the December issue, The Tool Engineer.



At right, the Grand Rapids No. 10-B Motor Driven Combination Drill and Tap Grinder, manufactured by the Gallmeyer & Livingston Co., Grand Rapids, Mich.

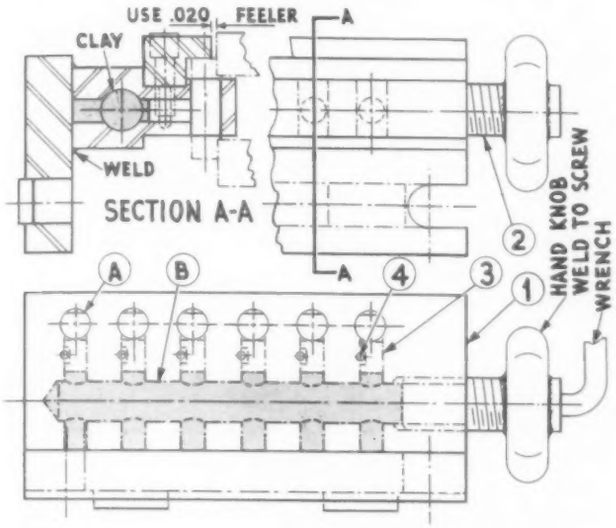
Below, the Ind-L-Way Drill Grinding fixture, by the Industrial Mfg. Co., Cleveland, Ohio.

GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Modeling Clay for Clamps

POSITIVE CLAMPING, acting on hydraulic principles, can be actuated by the use of modeling clay. Clamping pressure will be equalized, regardless of any reasonable variation in the workpieces, and construction is comparatively inexpensive, since the plunger holes do not have to be closely bored.



The fixture shown is designed to hold six workpieces, which have flats milled on both ends. This can be done with straddle mills in one pass. For high production, two fixtures can be used, one of which can be loaded and unloaded while the other is working. The fixture can also be used for grinding operations.

As operated, the workpieces are inserted in the locating holes, whereupon clamping pressure is exerted by turning the screw, detail 2. Displacement of the clay, in turn, acts on the plungers, detail 3, which are of drill rod altered to suit detail 4, which is a press fit in the base, detail 1. The flat on the plunger (3) should be slip fit to allow for required movement. The work holes (A) should be slip fit, without shake. The clay chamber B is drilled to suit the pressure screw, detail 2.

Frank J. Peragine
Greater New York Chapter A.S.T.E.

Steam Cleaning Detergent

OAKITE COMPOSITION No. 92, a new heavy duty alkaline-type detergent by Oakite Products, Inc., 57 Thames St., New York 6, is especially developed for use in modern steam guns and coil-type steam generating mechanisms. This new product promises greater speeds and lower costs in industrial steam cleaning.

The new detergent is described as providing fast and highly thorough steam cleaning action at very low concentrations. Advantages claimed are: prevention of scale clogs in steam coils; ready dissolution in hot water; free-rinsing action on all surfaces and safe and pleasant handling without offensive fumes or toxic vapors.

Magnetized Holddowns

AMONG OLD STAND-BY tools are the well known Work Holddowns, used extensively in milling and shaper uses. One trouble, however, is trying to hold them in place with one hand while trying to close the vise with the other. By magnetizing them, they will stick to the vise jaws sufficiently for temporary adjustment, and will therefore be more convenient as well as time savers.

Luther H. Bobbit,
Independence, Mo.

Thickness Gage for Enamel

THE USE OF A General Electric Type B thickness gage to determine the thickness, and hence the degree of white, of the porcelain enamel on stove parts at the Florence Stove Company, Kankakee, Ill., is saving that company $600 monthly by greatly reducing the number of rejected parts as well as speeding up the enameling process.

If a stove is to be all one shade of white, when assembled, the thickness of the enamel on the various parts cannot vary more than .0015". Before the thickness gage was used, individuals matched the parts visually after the enamel had been baked on. But, this was not as close an inspection as was necessary since, once the enamel had been baked on, it could not be removed and a new coating applied. As a result, there were many costly rejections.

With the gage, there is provided a double check on the thickness of the enamel. It is first used to determine the exact thickness which will give a desired shade of white, and the pressure control on an automatic sprayer is set to give just this thickness. Then, after a part is sprayed, it is checked, before being baked, to make certain that the correct uniformity has been held. If the thickness is not correct, the enamel can be washed off and the part re-sprayed.

The gage can measure the thickness of any non-magnetic material, from 1" to .0001" which is applied to an iron or steel base and the portability feature permits its use on several spraying lines at once.

Contributed.

GOOD READING

A Guide to Significant Books and Articles of Interest in the Trade Press

BEST'S SAFETY DIRECTORY, 1946-'47 Edition, published by *Alfred M. Best Co., Inc.*, 75 Fulton St., N. Y., is a 351-page "encyclopedia" describing industrial hazards and remedies or devices for each. It also lists names and addresses of manufacturers, distributors and local dealers for each piece of safety equipment illustrated. Cross-indexed for quick reference, the volume includes such subjects as eye and face protection, safety clothes, body and leg protection, vibration control, skin protection, scaffolding equipment, belts and accessories. Size of book, 8½" x 11", and it is now available at $5.00 per copy.

A **REPORT TO THE PEOPLE** is a 150-page book just released by *Stone & Webster Eng'g Corp'n*, N. Y., for limited distribution, describing over 40 projects on which the corporation concerned itself from the months before Pearl Harbor to V-J Day. Pictures of construction work on the Atomic Bomb Project are very interesting; especially such photos as those of a chemical building used for reclaiming of Uranium 235, even from the air itself. Also included are pictures of homes for workers, water cooling towers, fire station facilities, warehouses, and many process buildings of the electromagnetic plant at Oak Ridge, Tennessee.

This book is not a technical treatise on the details of constructing war plants in a hurry. Instead, it is the impressive history of Stone & Webster's extensive industrial achievements during World War II, which, in combination with thousands of other concerns, contributed so much to equip and supply our fighting men.

SELF-LUBRICATING BEARINGS MADE BY POWDER METALLURGY, by M. T. Victor, is available as a 5-page reprint from Keystone Carbon Co., Powder Metal Div'n, St. Marys, Pennsylvania. Originally published in February, *Electrical Manufacturing*, the article deals with established and tested procedures and processes wherein powder metallurgy has proven its advantages over other methods in the production of bearings and bushings. It is explained how by adjusting the pores in the metal to correspond to the lubricating oil viscosity, an automatic supply on the surface of the bearings may be assured.

Versatile Calculator

NEW CALCULATOR gives die opening and press capacity required for making 90 degree bends in mild steel and also in stainless steel of all commonly used gauges. For punching operations, the calculator indicates, on the reverse side, the tons per hole required to punch holes of eight different sizes in mild steel plate of a wide variety of gauges. The calculator is made of celluloid, in size 2½" x 4½", and should prove valuable for anyone concerned with bending and punching of steel. It can be obtained, without charge, by writing Verson Allsteel Press Co., 1355 E. 93rd Street, Chicago 19, Illinois.

QUALITY CONTROL AS A MANAGEMENT TOOL, by T. D. Foy, General Electric Co., in October *Machine Tool Blue Book*, attributes the present importance of quality control methods to wartime customers' insistence on better service, plus the now widely accepted principle of standardization and interchangeability of parts. The author warns, however, that statistical analysis is no cure-all, *per se*, but only when "corrective action is taken on the basis of this analysis" is it of any value.

The author proceeds to define quality control as "any organized management effort, statistical or otherwise, to establish and maintain required quality levels by suitable corrective and preventive action." This is followed by a detailed justification for such a definition.

Also, in the same issue, **NOW IS THE TIME FOR DEBT REDUCTION,** by Arthur Roberts, is an article for action *now* on the problem of the national debt. There has been little initiative originating in Washington on this vital matter, notes the author. As proof, he points out that governmental expenses—exceeding governmental income for every year since 1930—have now raised the national deficit to approximately $300 billion.

A higher deficit, and a still higher tax rate are predicted for the days ahead. This can be averted, the author concludes, if billion dollar doles to foreign governments are eliminated, and governmental wastefulness reduced, and some sort of plan initiated for drastic pruning of non-essential bureaucrats from the governmental payroll.

MAN-MADE WEATHER FOR METALWORKING, by E. J. Tangerman, in October 10th, *American Machinist*, attempts to prove that although everybody talks about the weather, much *is* actually being done about it through air conditioning. Since it is true that most creative work is done in the temperate zones of the earth, man has for many years tried to create a satisfactory norm of comfort while at work and play.

The author explains that more and more metalworking executives are undertaking, or considering the installation of some control of the atmosphere in their plants. Advantages pointed out are the achievement of closer tolerances, protection against corrosion, avoidance of static, reduction of cleaning costs, increase in worker health and efficiency, and a general decrease in employee absenteeism.

STEEL INDUSTRY FACES A PROSPEROUS FUTURE, by T. M. Girdler, Ch'man Republic Steel Corp'n, is also an optimistic prediction for all kinds of business. Writing in the October 1st, *Iron & Steel Daily News*, official paper of the Ass'n of Iron & Steel Eng'rs, Cleveland Exposition, the author believes, if the steel industry remains prosperous (and he predicts it will), the future of the nation is bound to be prosperous.

Mr. Girdler cautions, however, that unless strikes and industrial unrest are lessened, they "may have an unhappy effect upon an otherwise bright picture." Secondly, he warns against industrial over-expansion, of all kinds, to meet the currently abnormal demand for goods. Mr. Girdler's over-all view: 'as steel goes, so goes the nation.'

BULLETINS AND TRADE LITERATURE

Items briefed herein have been carefully selected for their interest and application. Unless otherwise stated, all are available, free, from the stated sources.

HANNA ENG'G WORKS, 1765 Elston Ave., Chicago 22, has released *Catalogue 23¼*, describing their line of cylinders for operation on air pressures up to 110 lbs psi; and with minor modifications — using air, oil, or water as operating medium — for applications up to 250 lbs psi. Interesting chart shows 15 basic movements—such as lever and toggle actions — all effectively handled by Hanna cylinders.

BALDWIN LOCOMOTIVE WKS, Philadelphia 42, has issued a bulletin—*Sonntag Universal Impact Testing Machine for Metals*—describing their machine which now has six possible testing ranges, plus a unique design of striking edge permitting quick adjustment for Izod, Charpy or tension testing.

Armor Milling Machine, a folder available from **AIRCRAFT MACHINERY CORP'N,** Burbank, Calif., illustrates Model JM Milling machine, with 8 speeds available—dual belts; 32 power feeds; with both horizontal and vertical spindles; 12″ longitudinal, 10″ vertical and 7″ cross travels; weight 320 lbs. stripped.

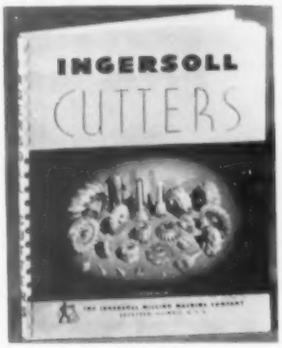
Bulletin No. 47, by **E. F. HAGER & SON,** 98-02 217th Lane, Queens Village 9, N. Y., lists attachments for extending application range of the Hager Carbide Tool Grinder to grinding of milling cutters, counterbores, inserted tooth face mills, spiral reamers, end mills and many other special type carbide tipped tools.

DIAMOND TOOL CO., 938 E. 41st St., Chicago, has issued a catalogue sheet—*Booth 3-Angle Turret Diamond Holder*—explaining how the automatic self-leveling action of their recently developed turret, with three separate drag angles for the diamond dressing point, provides three sharp cutting points for the clean and accurate dressing of wheels.

AMERICAN WELDING SOCIETY, 33 W. 39th St., N. Y. 18, still has copies available of its 68-page *Standard Code for Arc & Gas Welding in Building Construction*, at 50c per copy. This '46 edition, replacing the one issued in '41, includes revisions increasing allowable weld unit stresses equal to those allowed for the steel being welded. Other sections—on filler metal, workmanship, inspection and qualifications of welding operators and procedure—have also been revised.

J. K. SMIT & SONS, INC., 157 Chambers St., N. Y. 7, has a *Diamond Tool Catalog*, answering such questions as: "What are the important factors in buying diamond tools?" and "Which diamond tool prevents injurious overheating of the diamond?" Their line includes such products as blade and chisel tools, gage points and finger gages.

INGERSOLL MILLING MACHINE CO., Rockford, Ill., has a new 72-page *Catalogue No. 55*, describing their standard inserted blade cutters, with suggestions on proper selection and application, and ideas for use of special tools. One section is devoted to face mills; and among others are those on carbide tipped cutters, arbor cutters and machine accessories.



THE BULLARD COMPANY, Bridgeport 2, Conn., has just released a folder, *Bullard Man-Au-Trol Spacer*, describing their new semi-automatic movable work table to which work may be attached for accurate positioning in a multiplicity of predetermined locations under the spindle of various types of radial drills. For editorial appraisal of the Man-Au-Trol Spacer, see page 71, September, '46, *The Tool Engineer*.

ALEXANDER BROTHERS, 406 N. 3rd St., Philadelphia 23, has issued a new *Hydraulic & Pneumatic Leather Packing Guide*, listing four standard types of leather packings for hydraulic and pneumatic machinery—Cups, U's, Vees and Flanges. The company is fortunately equipped to provide three different tannages, each of which serves a specific purpose in relation to each packing installation.

S. B. WHISTLER & SONS, INC., 748-756 Military Rd., Buffalo 17, has released a folder—*Whistler Hydrodynamic Process*—explaining their new sheet metal drawing and embossing process wherein stampings are set with a fluid punch exerting uniform pressure all over. This patented method can produce tapered and cone shaped stampings in one operation, and it is now available for commercial use.

GALLMEYER & LIVINGSTON CO., Grand Rapids, Mich., has released a 31-page catalogue—*Grand Rapids Drill & Tap Grinders*—which, by its title alone, is description enough for those already acquainted with this reliable firm, and its policy of producing high quality machines at low cost.

MEEHANITE METAL CORP'N, 800 Pershing Sq. Bldg., New Rochelle, N. Y., has available *Bulletin No. 23*, describing Meehanite permanent molds used in the production of metals, glass, plastics and rubber.

DoALL COMPANY, 1301 Washington Ave., So., Minneapolis 4, Minn., offers *DoAll Equals Ten Plus*, a booklet showing savings effected with contour sawing on ten basic jobs requiring internal, external, three dimensional, radius, circular cutting and finishing operations. How the amount of work for shapers, lathes, and milling machines can be lessened — thereby conserving them for specialized work—is also explained.

TOOLS OF TODAY

Precision Form Grinder

A PRECISION **ANNULAR FORM GRINDER,** announced by the *Sheffield Corporation* of Dayton, Ohio, is the latest addition to its line of precision grinders and machine tools. This new machine, the first of this special type to be made available to American industry, utilizes the "Crushtrue" principle of wheel dressing for the rapid production of annular and cylindrical forms. Such, for example, as the grinding of circular form tools, crusher rolls, ball bearing seals, seaming rolls, shaft grooves in automotive and farm implement transmission gears, and other similar forms of intricate and precise profile.

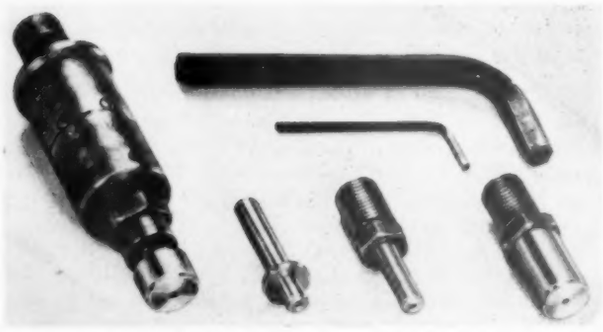
In some respects, the new machine tool is similar to the Sheffield Thread and Form Grinder, Model 101, which has been on the market for several years. This is true of the base, work table, wheel head, wheel feeding mechanism, and semi-automatic crush-truing device. The work head and work head drive, however, are completely new.

A variable speed geared-head motor drives the work head spindle (which may be of either live or dead center construction) in either direction through pulleys and two V belts over a spline shaft required for table positioning. The live center has provision for manual collet closing—maximum collet size .6875". Standard work speed range is 60 to 360 rpm and may be varied in infinite increments; however, additional work speeds—either higher or lower—can be arranged if desired.

A hand crank engages with the lead screw and is used for table positioning. The fine adjustment knob provides micrometer control of the table position and a table lock prevents any shifting of work with respect to the wheel during the work cycle. A precision spacing attachment, using the standard gage blocks and dial indicator, is available as an accessory; also, automatic infeed cycle is available as optional equipment.

Lathe Collet Stop

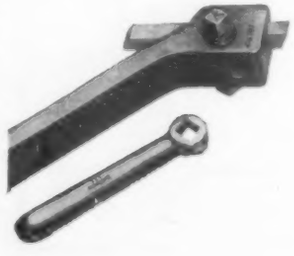
A NEW HARDINGE **UNIVERSAL LATHE COLLET STOP,** for second operation work, is a recent product of *Hardinge Bros., Inc.*, Elmira, N. Y. This accessory will convert any standard 1" capacity lathe collet into a solid stop or spring ejector stop collet without alteration of the standard collet. No machining of the collet is required, since the Stop is merely placed in the rear of the collet and securely anchored by a single locking bolt.



With spring ejector stop in place, the Universal Collet Stop will automatically eject parts when the collet is open—implying increased production in second operation work. The set is furnished, complete as shown, with collet stop body, one large and one small solid stop insert, one large and one small spring ejector and necessary wrenches. Complete information may be had from Hardinge Bros. Bulletin CS.

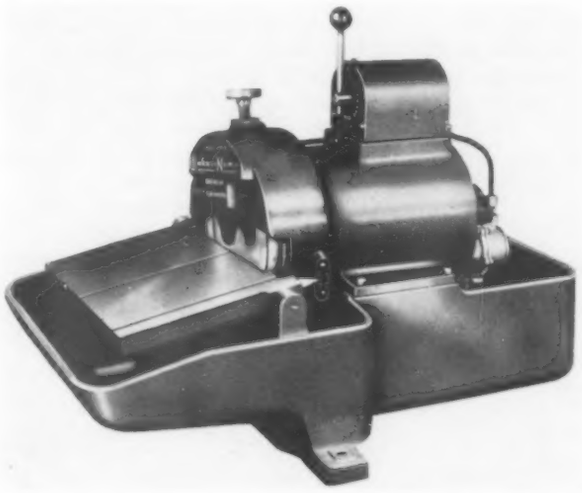
Precision Tool Holder

ELK UNIVERSAL PRECISION TOOL HOLDER performs the work of a score of different tool holders. The manufacturers—*Elk Tools, Inc.*, 96 Warren St., New York 7—state that the holder simplifies and speeds up machining operations. Bits can be removed for regrinding without disturbing setting of tool holder in tool post. Four holder sizes are available, and range from Model No. 00 with a $\frac{3}{8}$ x $\frac{3}{4}$ x $5\frac{1}{2}$ holder, and bit size $\frac{1}{4}$ x $2\frac{1}{2}$, up to the No. 2 model with holder $\frac{5}{8}$ x $1\frac{3}{8}$ x 7, and bit size of $\frac{7}{16}$ x $3\frac{1}{2}$.



Bench-Type Grinding Machine

A BENCH-TYPE **GRINDING MACHINE**, designed especially for sharpening carbide tools with a steel-bonded diamond wheel, is announced by *The Wickman Corporation, Detroit*. Known as the Wickman-Neven Bench Grinding and Lapping Machine, this machine has found wide acceptance in England and is now available in the United States and Canada through the Wickman organization.



For maximum convenience in sharpening both right and left hand tools, the direct-driven, steel diamond bonded grinding wheel is reversed by a switch on the top of the motor. The wheel guard can be swiveled, to right or left as required, and clamped in position by a thumbscrew, and the 8" x 12" table is quickly set at any angle from 5° above horizontal to 15° below. Ample power is provided by the 1 hp spindle motor, which is of special design to withstand very frequent reversal. A coolant pump is furnished as standard equipment, with a reservoir cast in the base of the machine.

Full details may be had in an illustrated bulletin, available on request from The Wickman Corporation, 15533 Woodrow Wilson Ave., Detroit 3, Mich., or from A. C. Wickman (Canada) Ltd., P. O. Box 9, Station N, Toronto, Ont.

Heavy-Duty Oil-Fuse Cutouts

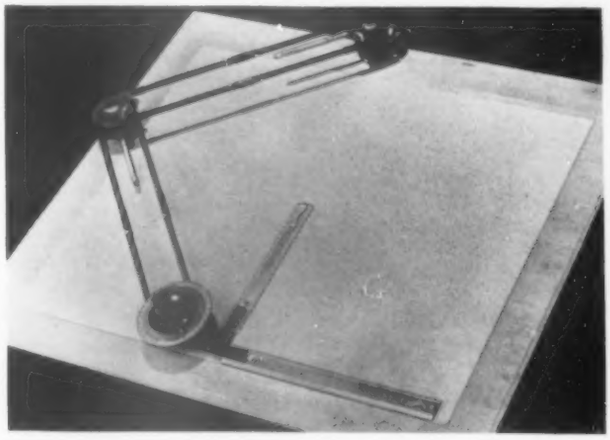
AN IMPROVED line of heavy-duty **OIL-FUSE CUTOUTS**, for overcurrent protection of power distribution systems in the 2400-, 4160-, 4800-, and 7200-volt classes, is available from the Transformer Division of the *General Electric Company*, Schenectady 5, N. Y.

Utilizing the new universal fuse links which provide higher interrupting ratings, the improved cutouts clear fault currents as high as 11,000 amperes, depending upon the rating. With this new design, 100-, 200-, and 300-amp rating cutouts with maximum short circuit interrupting ratings previously limited to 2500 volts are now extended to 5000 volts. And, as there are no exposed live parts, and no arc flames are ejected during current interruption, they provide a high degree of safety.

G. E. Bulletin GEA-732-J, available upon request, gives full information.

Universal Drafting Machine

A NEW MODEL drafting machine—the Universal **BOARDMASTER**—is announced by *The Universal Drafting Machine Company* of Cleveland 14, Ohio. Completely redesigned, engineered and developed throughout the war years, the Boardmaster marks a great advance over previous models in ease of operation, precision accuracy, ruggedness and versatility and offers many new features never before found on a drafting machine.



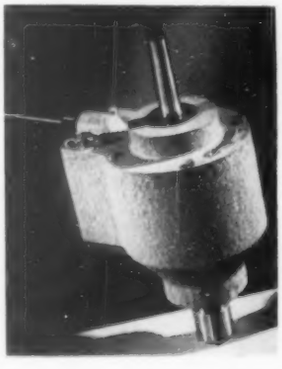
For the first time, a "Centralized Control Group" locates *every* operating control at the fingertips of the left hand. Placed for easy, natural operation, all controls are grouped within a 2 inch radius; as a result, the Boardmaster can be operated virtually by feel alone—without visual reference. The "over-arm" protractor permits full visibility of the dial throughout 360° and in any arm position.

Drill Press Tap Head

DESIGNED TO FIT any standard drilling machine, new **TAP HEADS**, by the *R. G. Haskins Company*, 615 S. California Ave., Chicago 12, are now available in three sizes: No. 1, with either No. 1 or 2 M.T. Shank; No. 2, with No. 2 or 3 M.T. Shank, and the No. 3 heavy duty. The latter, for extra rigidity, is supplied with a quill type adapter. However, any of the heads can be furnished with a special adapter, or quill clamps, to suit installation requirements.

Each size head is designed to tap within definite capacities, viz: Rated capacity, in mild steel or brass, is up to ¼" for the No. 1; No. 6 to ⅜" for the No. 2; and No. 8 to ½" N.F. for the No. 3 head. The tappers reverse at twice the tapping speed. If desired, the head can be furnished with a special combination tapping and external threading spindle, with which standard Acorn type dies can be used without extra adapter or holder. For maximum efficiency, individual ground collets are available for each type.

In operation, when the tap contacts the blank, the clutch is automatically seated, with cushioned effect, in the drive shell. However, there is enough sensitivity so that, in event of seizure or obstruction, the clutch will slip and prevent tap breakage. At the bottom of the stroke, when the tap head is retracted, the clutch is immediately engaged by the reverse speed. This changes direction of rotation and permits the operator to float the tap out of the tapped hole.

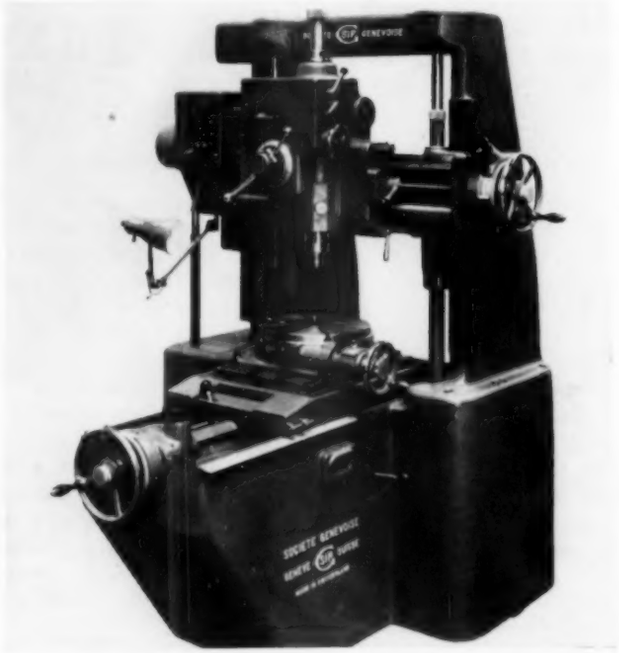


New Swiss Jig Borer

A NEW Sip High Precision **JIG BORER**, Type 3K, is announced by the *Cosa Corporation*, Chrysler Bldg., New York 17, representatives in the United States for Societe Genevoise D'Instruments de Physique of Geneva, Switzerland. Sip Jig Borers are known throughout the world for their high precision and ease of operation, and the 3K holds to known quality.

It is built along the lines of the Sip planer type, with a table working surface 20½" x 15", and incorporates built-in measuring screws and micrometer heads. Direct readings are made to 0.00005" on the verniers of large dividing drums, with automatic correctors to compensate for possible errors in the measuring devices. Guaranteed accuracy for all settings, of work table and spindle saddle, is plus or minus .0002".

The machine has eight spindle speeds, ranging from 75 to 2000 rpm, with six automatic feeds in either direction. The cross rail is traversed vertically by a motor driving two heavy, precision elevating screws which, extending downward into the bed, are automatically lubricated. The machine is also provided with a special guiding arm to facilitate the boring of very small holes, and a depth measuring device which, like the guiding arm, can be mounted on the spindle head to permit the boring head to be accurately limited. Besides its use as a precision jig borer, the machine can be used for production boring and also as a dependable measuring machine.



Nylon Faced Hammers

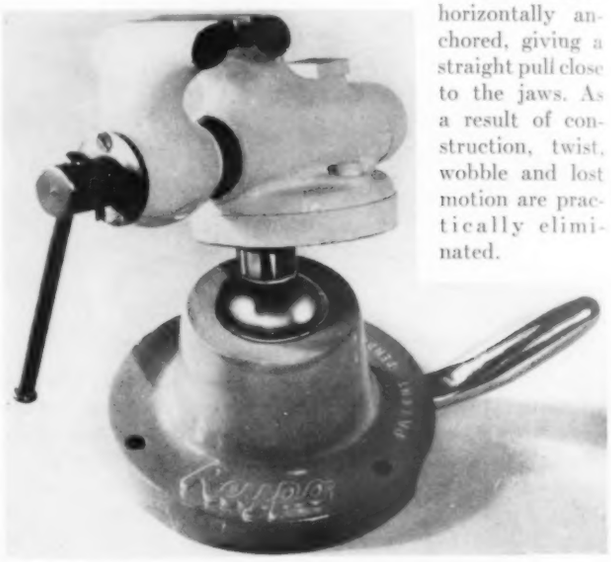
A NEW **SOFT HAMMER**, by the *Danielson Mfg. Co.*, Danielson, Ct., features replacable nylon facing. Advantages claimed for this facing is excellent performance, with longer wear. It does not chip or mushroom, is resistant to chemicals, oils and fire, and does not heat up or distort under continued use. Present models are available in ⅔ and 2-lb. weights.

Universal Ball Vise

DESIGNED FOR holding work at any desired angle, a **UNIVERSAL BALL VISE**, by the *Reypo Corporation*, 990 Lincoln Blvd., Los Angeles 45, is an extremely versatile tool for use by tool, die and instrument makers, and others requiring a fast, positive, all-angle work holding fixture.

The body of the vise is entirely enclosed, to exclude dust and chips, with the base a close grained, high quality casting. The ball is accurately finished and hard chrome plated, and the universal ball base is so constructed that the vise can be instantly and positively locked in any position.

Jaws are hardened to 55-58 Rockwell "C," and ground parallel to aid in compound angle setting. Among other features, the nut is horizontally anchored, giving a straight pull close to the jaws. As a result of construction, twist, wobble and lost motion are practically eliminated.



Shearcutter Tool Bit

CLAIMED TO BE REVOLUTIONARY in that it takes cuts several times normal size, a new tool bit—The **SHEARCUTTER**—by the *Fearless Tool Co.*, 1234 So. Gramercy Place, Los Angeles 6, portends savings to the metal cutting industry.

Using the principle of molecular cleavage, this tool cuts metal with a knife-like action instead of chiseling it off by the rupturing method employed with conventional tool bits. Digging in, and chattering, is said to be prevented by the radically new method in which the tool uses the chips removed in cutting. This action tends to keep the cutting edges sharp, while the shearing action makes possible a depth of cut several times the normal size of the bit used. For example, the illustration shows a ⅜" shearcutter bit taking a 1⅛" cut under power feed, in cold rolled steel.

Electric-Air Tapper

ENGINEERED FROM SCRATCH, the type U Electric-Air **TAPPING MACHINES**, by the *R. G. Haskins Company*, 615 So. California Ave., Chicago 12, are new from the ground up. The design embodies new principles in air cylinder construction, a new air operated table raising and lowering unit, with more sensitive air regulation and controls, greater accessibility to control units, new automatic and semi-automatic fixtures and a highly sensitive Electric-Air Control.

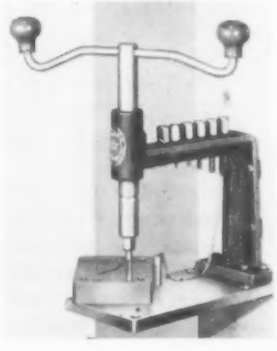
Styling—to use that term—is reflected in the smooth lines, while thought to "little things" that make for operator convenience is indicated in the wide, bale type foot lever. A rigid, welded column encloses the control units, accessible through a door the full length of the chamber. The air head is of cast aluminum, with bronze cylinder walls and graphite carbon pistons—resistant to rust and corrosion that may result from moisture in the air lines.

The Air-Electric control increases sensitivity in the application of power, and permits extreme accuracy in depth of stroke. Micro-Switch actuated solenoid valves, with sensitive pressure control, provide automatic or controlled operating cycle as well as means to synchronize the electric-air fixture with the stroke of the tap head. In all, the machine offers broad means of control and fixture application.

By means of panel switches on the side of the pedestal, the operator can select any of three methods of cycle control. With the selector switches in one position, the insertion of the part into the fixture actuates the complete down and up stroke of the tap head. By turning the switch to the second position, the operator can control the cycle at all times. With the switch in still a third position, the operator can obtain complete tapping cycle through a momentary contact of the foot pedal. All circuits are built-in and require no changes, hence, there is no delay in change-over nor any additional cost except for the fixtures.

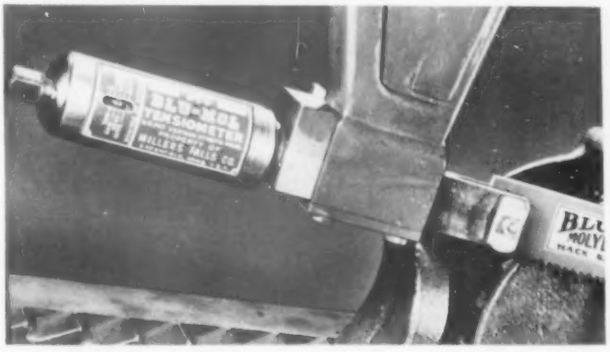
Tap Guide Reduces Breakage

A NEW **TAP GUIDE**, product of the *Dahlstrom Mfg. Co.*, 420 J S. Sixth St., Minneapolis 15, practically eliminates tap breakage, considerably reduces hand tapping time and turns out a job that is always straight and true. The tool fastens to the bench—or to the post if so desired—and can be handled by inexperienced operators. It comes equipped with seven adapters, ranging from 8-32 to ½", which takes care of the majority of tapping operations. The price is $42.50 F.O.B. Minneapolis.



Hack-Saw Tensiometer

THE *Millers Falls Company*, Greenfield, Mass., has developed a **"TENSIOMETER"** designed to set and maintain correct blade tension on power hacksaws. The device—a small cylinder enclosing a strong, calibrated spiral spring—is easily attached to the blade holder of the machine and acts as a shock absorber for the blade, automatically compensating for changes of feed pressure, thermal expansion and contraction and unusual shocks such as the blade striking a hard spot in the metal being cut.



By positively controlling any desired tension from 0 to 4000 pounds the "Tensiometer" is claimed to: Improve the accuracy of cut; maintain substantially constant tension in spite of lengthening of the blade due to heating and eye elongation; absorb shocks, minimize blade breakage, and to greatly improve the complete cutting operation.

By reading the calibrated indicator, the machine operator can readily set the tension at the desired figure; for instance, a tension of 3000 pounds can easily be set by hand without using a wrench. The company states that it will gladly arrange trial runs on the machines of any firm—large or small—that desires a demonstration. Further information may be had from the maker.

New Tool Grinder

AVAILABLE IN THREE UNITS—bench grinder, floor stand and fixture—a new **TOOL GRINDER** that makes radial-helix relief grinding easier than regular angular back off relief grinding is announced by the *D-S Grinder Division* of Royal Oak Tool and Machine Co., Royal Oak, Michigan.

Known as the D-S, the new grinder provides for radial relief sharpening right to the cutting edge with sharp intersections and no undercuts. Any desired margin can be left on the blade sides, and radial and helical relief can be produced simultaneously and can be varied to suit all practical requirements.

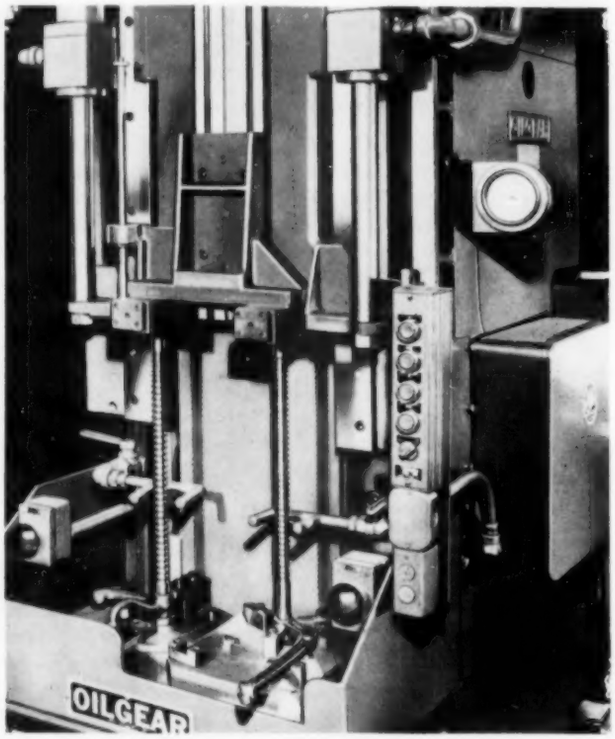
Cam and index plates provide for grinding any tool of one to 12 flutes with identical relief on each blade. The D-S may be described as a universal machine that can be used for relieving end cutting, form, taper or side cutting tools, flute grinding and circle grinding as well as other tool grinding operations. Tools are supported rigidly between centers or in a collet.

A new folder — No. 46 — fully describes this moderately priced equipment.

New 'XP' Broaching Machines

FIVE SIZES of new style type "XP" **VERTICAL PULL-DOWN BROACHING MACHINES**, varying in normal pulling capacity from 5 to 37½ tons and broaching strokes from 24 to 66" are now offered as standard equipment by *The Oilgear Company*, Milwaukee 4, Wisconsin.

Outstanding features, claimed for these machines, result in increased production and savings in time, effort, tools and power. Included in the design are automatic tool handling mechanisms with adjustable bracket for tools of varying lengths; automatic puller operation; dual safety pushbutton control with selector switch for manual or semi-cycle operation. Also, oilgear regenerative stabilizing circuit; interlocked operation of tool handling carriage and tool pulling slide; automatic pressure lubrication of tool slide, carriage and ways; positive lubrication of work and tools; knee bar emergency stop; motor driven cutting fluid pump and oilgear controlled fluid power operation.



Each size of machine is equipped with an Oilgear Type "DX" Two-Way Variable Delivery Heavy Duty Radial Piston Fluid Power Pump, arranged for direct drive and of sufficient capacity to provide variable broaching speeds up to 30 feet per minute and independently variable return speeds up to 80 fpm. Self-contained and complete, these high speed broaching machines are said to pull peak loads up to 150% of normal capacity, with preset relief valves, built in the pump, protecting work and machine against overload.

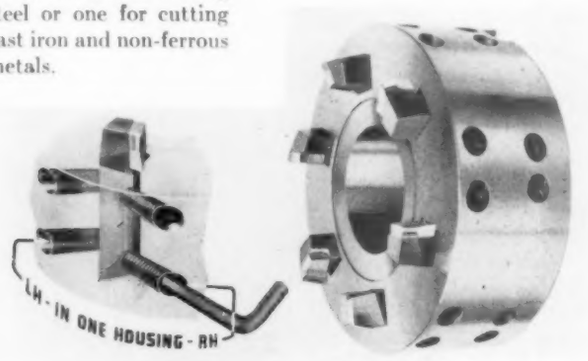
When broaching, operator merely loads and unloads work and depresses the simple dual safety push-button control. The upper carriage and tools descend to insert tool shanks through the work and table into pullers. The main slide automatically pulls the tools downward through the work and stops, work is unloaded, operator depresses push-buttons, main slide and tools return upward, upper carriage receives tools and lifts them upward to loading or starting position. There are no tools to handle, and no control or clamp levers to fatigue the operator.

New Face Mill

A NEW TOOL-BIT TYPE **FACE MILL**—called the "Cutsall"—equipped with Carboloy cemented carbide blades and embodying several unique features, has been announced by *The Lovejoy Tool Company*, Springfield, Vt. Designed especially for modern milling practice, the housing is built to take either left or right hand blades. Blades are held slightly back of center, so that positive and negative radial rake can be obtained from the same blades.

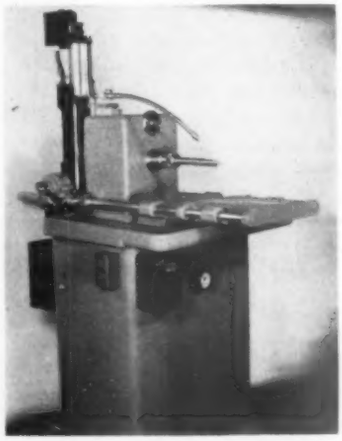
As shown in the phantom view, there are two set screws for each blade. One bears on the tapered base of the blade and provides for fine adjustment, while the other locks the blade securely in the housing. The blades have extra long carbide tips and can be sharpened on an off-hand, adjustable table single-point tool grinder in the same manner as regular lock tools.

In construction, the cutter is rugged and balanced, for heavy cuts in tough stock at high spindle speeds. It is available in 6", 8", 10" and 12" diameter sizes. For additional economy, one size of blade fits all cutters, and blades are tipped with either of two grades of carboloy cemented carbide—one for cutting steel or one for cutting cast iron and non-ferrous metals.



New Honing Machines

A NEW SEMI-AUTOMATIC **HONING MACHINE**—Model B-6—is now available from the *Staple Engineering Co.*, 1315 South Woodward Ave., Birmingham, Mich. Designed to hone parts from ¼" to 2½" inside diameter, the machine has a 7" stroke and is electrically controlled and air operated. It is manually adjusted for size.



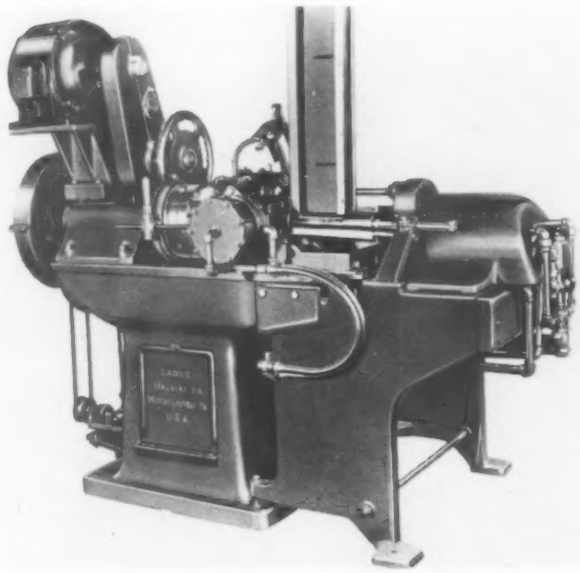
The honing cycle is adjustable from 3 to 180 seconds. Stroke is also adjustable, and any speed from 40 to 180 strokes per minute may be readily obtained. The standard Staple two-stone hone is used, and one mandrel is said to produce from 10,000 to 30,000 parts, finish honed. Stones can be supplied for most materials.

The honing cycle is entirely automatic, and all that is required of the operator is to load the part in the work holding fixture (not shown) and to press a button.

Advantages claimed, over hand stroked machines, are: Faster stroking, with the economy resulting from more parts per unit of time; de-skilling of honing operation and the further economy of gang operation since one operator can run two or more machines.

Automatic Nipple Machine

AN **AUTOMATIC NIPPLE MACHINE**, developed by the *Landis Machine Co.*, Waynesboro, Pa., is designed to thread ream, and chamfer both ends of space nipples automatically. The machines are built in two sizes—the 1¼" machine for ½", ¾" and 1" pipe sizes, and the 2" machine for 1", 1¼", 1½" or 2" pipe sizes.



The machines have two spindles, each equipped with Lanco Internal Trip Semi-Receding Pipe and Nipple Threading Die Head and Reaming Attachments. The two carriages have air operated vises for gripping the nipples, and the left hand carriage carries an adjustable magazine from which the nipple blanks are fed automatically into the machine.

In operation, the nipple blanks (cut to desired length) are placed in the magazine where they are fed into the machine, one for each cycle. Released from the magazine, the nipple blank is pushed into position in the grips, following which an air vise closes to hold the blank in position and against turning. The left hand carriage then rapid traverses to the thread starting position and assumes a feed rate to produce the required thread lead, the entire carriage movement being controlled by an accurately machined cam.

After the required length of thread is cut, and the chamfering and reaming operations completed, the left hand die head and air vise open automatically and the carriage returns to the loading position. At this time, the cam controlled air operated transfer mechanism removes the semi-finished blank from the left hand carriage and places it in the loading position for the right hand carriage, turning the nipple end for end as it moves into position over the second carriage. The semi-finished nipple is then pushed into position in the air vise of the right hand carriage where it is gripped to be reamed, chamfered, and threaded in the same manner as the first end was on the left hand carriage. After completion of the second threaded end, the nipple is discharged from the machine.

The machines are driven by a constant speed motor, with change gears provided to give the required spindle speeds for the pipe size to be threaded. A safety clutch is built into the drive to prevent serious damage if a jam should occur. The drive and cam mechanisms are enclosed, and convenient lubrication devices are provided for all bearings.

Lubricator for Band Saws

A NEW AND UNIQUE **SPRAY LUBRICATOR**, announced by the *DoALL Company*, Minneapolis, provides a clean, economical method of heat dissipation when sawing metal with high speed band saws. The attachment, simple to install, is a rugged, heavy duty device and operates from standard air pressure lines.

The spray head straddles the saw blade from the back side and directs twin streams of lubricated air against the teeth of the saw. Thus, lubricant is forced under pressure, in the form of metered mist, into the saw teeth as they enter the work. The work table does not get wet or messy.

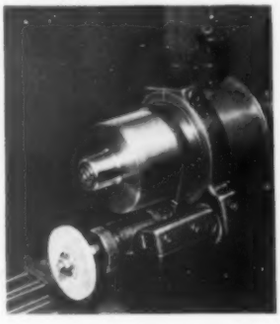
Primarily designed for use in cuting non-ferrous metals, the Spray Lubricator works equally well on many types of plastics and laminated material when friction between work and blade tends to soften the material to a gummy state. Taken as a whole, experiments in connection with its development indicates that it is one of the major improvements in high speed sawing and that it portends sensational results in faster cutting rates, extended saw life and superior finish.

Surface Grinder Attachment

A NEW HIGH SPEED **SURFACE GRINDER ATTACHMENT**, known as the Stafford "Blitzrev," is now available from *D. & S. Model Co.*, 3114-58 E. 3rd St., Dayton 3, Ohio. The attachment can quickly be installed on most standard makes of surface grinders and permits use of small grinding wheels from ⅛" mounted quills to 3" diameter. Speeds of 10,000 and 15,000 rpm are attainable with the standard 2-step pulley, with higher speeds available with a special pulley.

Dust and dirt are excluded from the housing by means of air flushing principle, whereby a fan mounted on the revolving shaft sets up an outward airflow. A drive pulley, mounted on the surface grinder spindle, replaces the standard wheel and drives the high speed auxiliary spindle through a belt.

A dovetailed arrangement allows a forward and backward movement of the "Blitzrev" attachment, permitting grinding over the full surface of the magnetic chuck with a 2" wheel. The attachment may also be swung through 360°, to extend the range of travel from right to left. Six standard quills, with proper wrenches, are furnished as regular equipment, and the complete unit comes in a neat wooden chest.



North East West South in Industry

MILTON C. EKBERG has joined **Johnson-de Vou, Inc.**, Worcester, Mass., and will be in charge of the new Springfield office. Mr. Ekberg attended Worcester Polytech, and served in the Navy, having been released with the rank of lieutenant. Before the war he was with the Norton Company as a field and abrasive engineer.

Warren Ames, President of the reorganized **B. C. AMES CO.**, Waltham, Mass., has announced that the firm will continue manufacture and sale of micrometer dial gauges and micrometer dial indicators. However, manufacturing rights in Ames Bench Lathes, Milling Machines and Hardness Testers have been sold to **AMES PRECISION MACHINE WKS.**, Waltham, headed by **Ira R. Ames**, who was formerly affiliated with the B. C. Ames Company.

FRANK G. SHAUB has been appointed Detroit representative for **Chambersburg Eng'g Co.**, Chambersburg, Pa. For many years connected with the Ford Motor Co., where he specialized in maintenance of steel mill and forging equipment and forging die development, Mr. Schaub is well known in Detroit.

HANNIFIN MFG. COMPANY, Chicago, manufacturer of pneumatic and hydraulic production equipment, has appointed **Harvey P. Barnes**, 345 E. 218th St., Euclid, Ohio, sales engineer for Cleveland and northern Ohio. Additionally, they announced appointment of **George O. Hendee**, 404 Mill Rd., Havertown, Penna., sales engineer for the Philadelphia area, which includes southern New Jersey, eastern Penn., and Delaware. Mr. Hendee was recently released from the Army as a lieut. colonel, after five years service with the General Staff Corps.

M. O. SHEPHERD (left), Works Mg'r, **Bunell Machine & Tool Co.**, Cleveland, has completed a study of manufacturing trends, revealing a marked increase in the demand for specially built machines. Bunell has thus inaugurated, among other new services, a program of advanced research for determining special machine designs before receipt of orders. Mr. Shepherd also announces promotion of **Victor Voigt**, formerly assistant chief engineer in charge of design for Bunell, to the position of chief engineer.

James E. Allen has been elected Executive Vice-President, **THE ARO EQUIPMENT CORP'N**, Bryan, Ohio, according to announcement by **J. C. Markey**, President. **R. W. Morrison**, sales and tool div'n manager, has announced ten divisional appointments in the Industrial Pneumatic Tool Div'n, as well as the assignment of several additional jobbers in the states of Virginia, Tennessee, Kansas, Washington, California and also in Ontario, Canada. Additionally, **E. L. Jackson** and **M. J. Anderson** have been named Ass't Sales Managers of the Air Tool Division for Aro.

Six administrative departments of **BUNDY TUBING COMPANY** have moved into newly remodeled offices on E. Jefferson at Parker Avenues, Detroit. A general expansion program also includes a new research laboratory in that city. Bundy's main plant in Detroit is now producing up to 50 million feet of tubing per month by the Bundyweld process.

EARL J. BREECH, Gen'l Mg'r and Treasurer, **Merz Eng'g Co.**, Indianapolis, Ind., has been elected to the board of directors of the parent concern, Marmon-Herrington Co., Incorporated. Mr. Breech is also a director of Merz Eng'g, whose principal products are plug and ring gages, jigs, special gages, tools and fixtures.

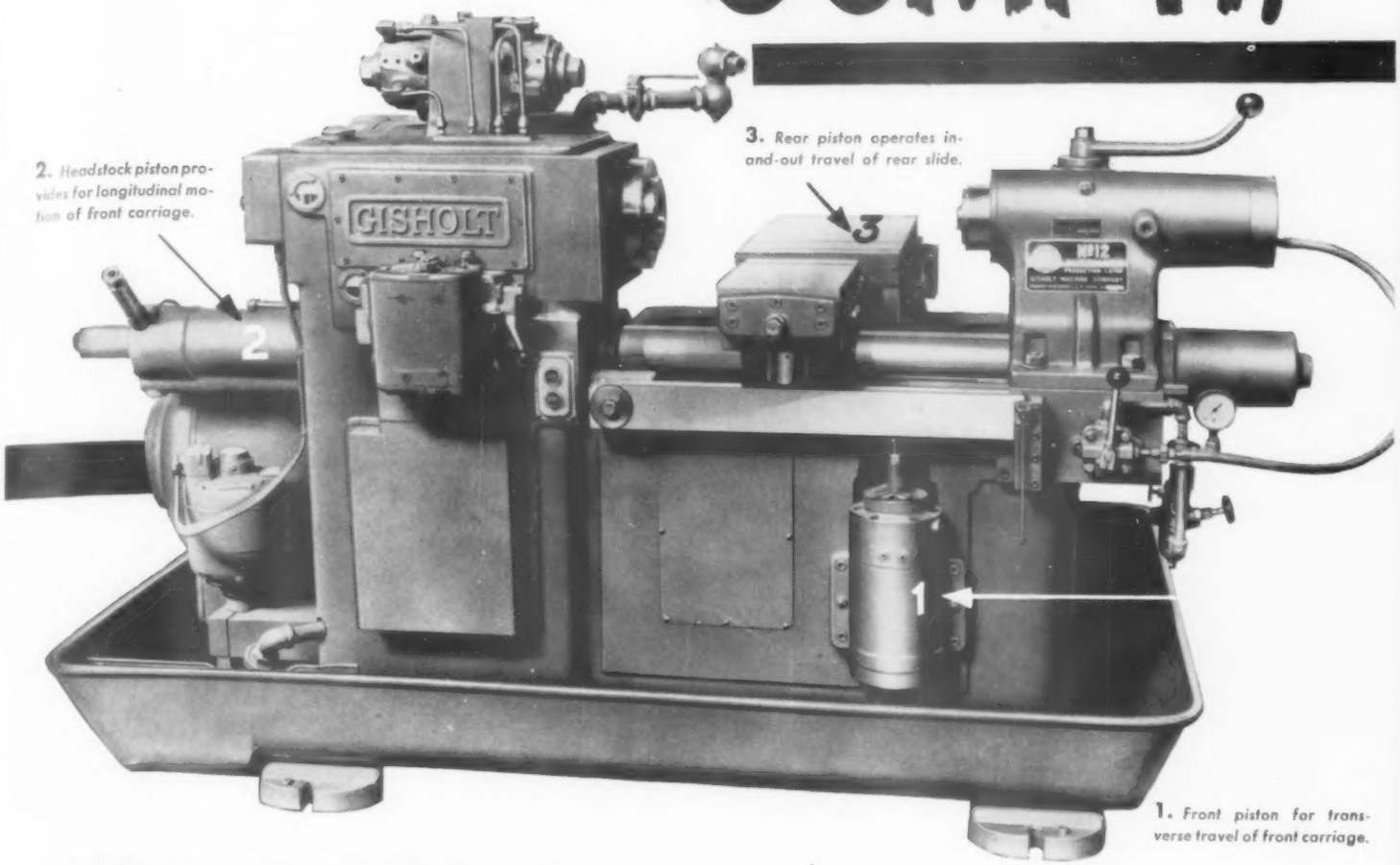
HEBERT EQUIPMENT CO., manufacturer of machinery and hydraulic equipment, is now established in its new plant at Romeo, Michigan. Branch offices will continue to be located at 7310 Woodward Ave., Detroit, according to **Fred C. Hebert**, President.

RUDEL-CAREY, INCORPORATED—sales distributor in the New York metropolitan area for such products as carbide cutting tools, grinding wheels, machine tools and accessories, as well as materials handling equipment—is now established in new quarters at 435 4th Ave., N. Y. 16. According to announcement by **Andrew G. Carey**, President, distribution agreements have been established with a score of companies, and a staff of sales engineers appointed.

NAT'L METAL CONGRESS & EXPOSITION at Atlantic City, Nov. 18 through 22, includes exhibits of close to 400 manufacturers, as well as many technical meetings and discussions. **American Society for Metals** program includes over 20 technical sessions, plus four educational lecture courses. **American Welding Society** schedule calls for papers on weldability, electrodes, and resistance welding, as well as discussions on related research and production problems.

American Institute of Mining & Metallurgical Engineers, also meeting at the Nat'l Metal Congress & Exposition, have scheduled many technical meetings such as those on physical chemistry of blast furnaces and open hearth, and a joint symposium on effects of multiaxial stress in metals. The **American Industrial Radium & X-Ray Society, Inc.**, will also hold a series of meetings.

operating cycle with "OOMPH!"


2. Headstock piston provides for longitudinal motion of front carriage.
3. Rear piston operates in-and-out travel of rear slide.
GISHOLT
2
3
1
1. Front piston for transverse travel of front carriage.

THE GISHOLT HYDRAULIC AUTOMATIC LATHE

You'll admire the way this husky little lathe goes about its business. Completely automatic, the operator has only to chuck the piece and touch the control valve handle. All tool travel—including rapid approach, feed during cut, tool fade-out, and rapid retract at the end of the cycle—is by hydraulic pressure. Three hydraulic cylinder units, as indicated above, actuate all tool movements.

The front piston elevates the guide bar, advancing front carriage tools transversely to cutting position. The headstock piston moves the front carriage longitudinally to complete the turning—after which tools fade away, both cross and lengthwise, by controlled, hydraulic relief.

Simultaneously, the rear slide piston advances tools rapidly and feeds them through the cut. Tools for both carriages are rapidly returned to starting position as soon as the rear slide has completed its work. At this point the driving clutch is disengaged and the spindle brake applied. The total machining time for the piece is the time of the longest cut.

This genuinely rugged automatic lathe performs equally well on arbor or between-centers work, chucking jobs, or work held in special fixtures. Write for complete details.

•

GISHOLT

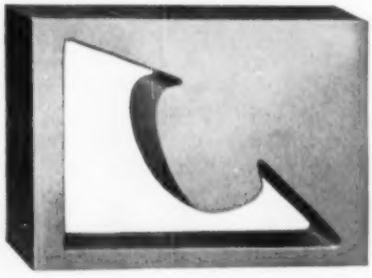
GISHOLT MACHINE COMPANY

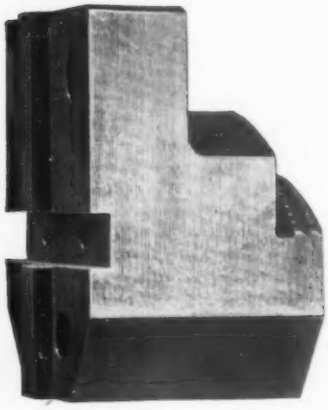
1257 E. Washington Ave. • Madison 3, Wis.

Look Ahead..Keep Ahead..with Gisholt

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

BTR IS A Safe-Hardening TOOL and DIE STEEL





A steel that hardens safely—that quenches without cracking—is like money in the bank to the tool- and die-maker. That's why Bethlehem Tool Room (BTR) is the recognized leader in its field.

When there are drastic dimensional changes in the die or punch—when there are sharp, angular corners or round corners with small radii—when there are many holes separated by thin webs—play safe and insist on BTR.

Its safe-hardening characteristics are due in part to the following reasons:

(1) Balanced analysis of manganese, chrome, tungsten, and vanadium.

(2) Ability to oil-harden at relatively low temperatures.

Here is a steel that holds its size and shape in the heat-treating process. You'll find, too, that in the ideal quenching and tempering range, it hardens to a Rockwell C of 62-63. Moreover, it is easy to machine and is high in both wear- and shock-resistance.

BTR is an old, reliable performer. To minimize cracking dangers, always make sure that it's stocked in your tool room.

TYPICAL ANALYSIS:

C	Mn	Si	Cr	W	V
0.90	1.20	0.30	0.50	0.50	0.20

BETHLEHEM STEEL

BETHLEHEM TOOL ROOM . . . one of Bethlehem's *Big 8* Tool Steels

For Precision Threading at High Production

LANDMACO THREADING MACHINE

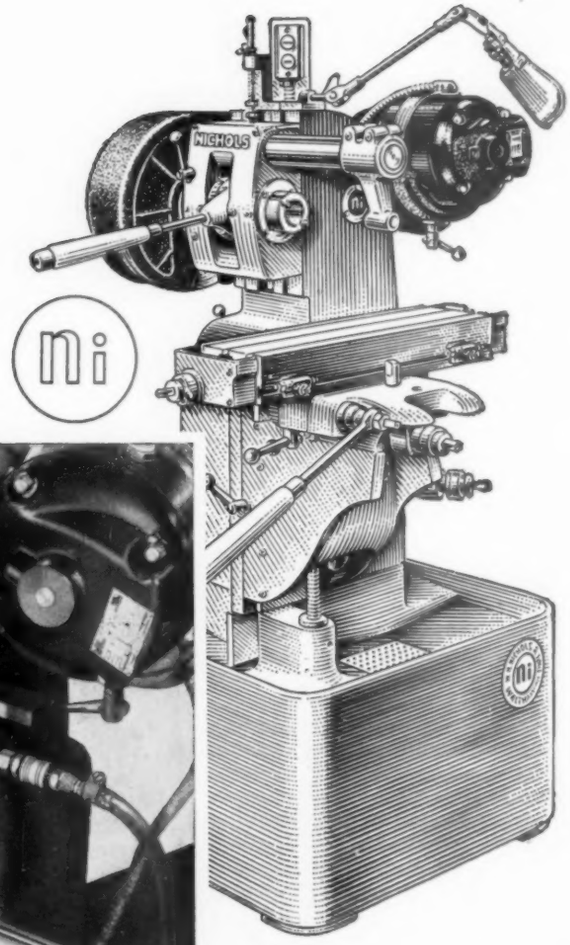
The LANDMACO Threading Machine equipped with the LANCO Head will give you quality threads at low operating cost.

It can readily be set up to handle all types of threads and it assures smooth-finished well-formed threads of class 3 fit on the toughest alloy steel.

Write for Bulletin H-75

LANDIS MACHINE CO.
WAYNESBORO · PA. · U. S. A.

More power to you
More speed to you
More profit to you



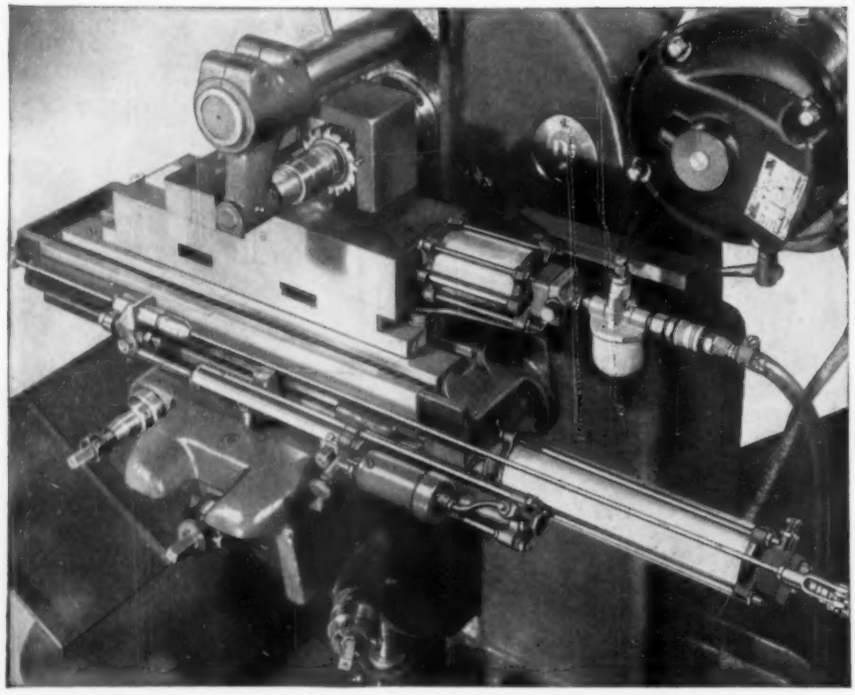


Photo shows Nichols power feed attachment installed. In this case, work is held in an air-operated vise

...with the *New Nichols* Power Feed Attachment

Here is a tested and proved power feed attachment that is an added production asset for *any* Nichols Miller. It is designed to reduce the time of the operating cycle and reduce the operator's duties so that often one operator can run two or more machines.

This power feed attachment is designed for fast table advance — maximum proper cutting feed — fast table return — automatic shut-off. It is completely automatic except for loading and unloading the work. Rapid traverse and work speeds are easily and quickly changed to suit all classes of jobs within the capacity of the machine.

Basically this attachment is a Bellows air feed unit used in conjunction with a Hydro-Check. Thus a positive, infinitely variable feed is obtained throughout the 9" maximum cutting stroke by using regular shop air lines with 75 to 175 lbs. pressure.

The Nichols power feed attachment can be installed either before or after shipment of the Nichols Miller. *It can be installed quickly on any Nichols Miller ever built.* Write for details.

Send for free Nichols Miller Catalog

THE *Nichols* MILLER

MANUFACTURED BY W. H. NICHOLS & SONS, WALTHAM, MASSACHUSETTS

NATIONAL DISTRIBUTORS: NICHOLS-MORRIS CORP., 46 CHURCH ST., NEW YORK 7, N. Y.

do you have

Oil Seal Troubles?

Superfinish

can solve them!

For example, here's the case where a shaft with two oil seal bearings was installed with ground surfaces. Driven by a ¾ h.p. motor at 1,750 r.p.m., the oil seals created enough heat to burn the shaft and stop the motor. To make matters worse, it was later found that twice the original speed was necessary.

These oil seal surfaces were *Superfinished* and a new motor installed which turned the shaft at 3,500 r.p.m. With the *Superfinished* surfaces, no heat was developed at this increased speed. No further trouble was encountered.

Superfinishing is a quick, simple and inexpensive process. Oil seal bearings are but one of the many applications where it can save money, not only by eliminating trouble, but in many cases, by reducing your manufacturing costs as well. Gisholt engineers are ready to advise you concerning its applications.

GISHOLT MACHINE COMPANY

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Look Ahead...

Keep Ahead...

with Gisholt...

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

A Complete Blade Service

The MARVEL System of Metal Sawing provides not only the most advanced and most complete line of metal sawing machines built, but also a complete metal-cutting blade service which includes:

(1st) MARVEL High-Speed-Edge Hack Saw Blades—positively unbreakable, composite blades with a high speed steel cutting edge welded to a tough alloy steel body. Hardened "eyes" permit greater blade tension. Extra strength makes practical greatly increased speeds and feeds—in fact, these blades make possible today's fast automatic hack saw machines.

(2nd) MARVEL High-Speed-Edge Hole Saws— hole saws with strength for use on drill presses and lathes. Diameters from ⅜" to 4½" with high speed steel pilots. Cut big holes at low cost in steel to 1⅛" thick.

(3rd) MARVEL Metal-Cutting Band Saw Blades come ready-welded (endless) and individually boxed. (*Order by make and model of machine and number of teeth per inch.*) MARVEL'S individual boxing prevents damage to teeth, kinking or loss thru rust in shipping, storing or handling. Specify MARVEL Band Saw Blades for top quality and top performance.

ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

5700 Bloomingdale Ave. Chicago 39, U.S.A.
Eastern Sales Office: 225 Lafayette St., New York 12, N. Y.

Get Three Big Advantages

- Greater Accuracy
- Higher Production Rate
- Lower Cost

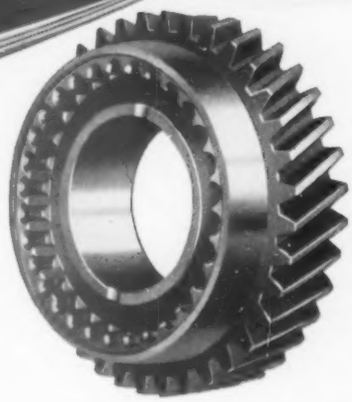
with Unskilled Operators

HERE is another example of how a Cross machine, utilizing "Selected Sequence" in automatic cycle operation, met the requirements by producing more accurately, at a higher production rate, at lower cost, with an unskilled operator. Further, it made possible a change in product design which added strength to the gear it produced, and improved resistance to sudden or heavy torque loads.

The No. 52 Milling Machine is made up of standard machine parts to provide a low cost, compact unit for specialized requirements, yet readily adaptable to a wide variety of work—for profile milling, for milling numbers of equally spaced internal or external slots, or for diversified operations on gears.

In action, the special form end mill rapidly advances horizontally to a predetermined position inside the gear and then feeds upward. After milling, the cutter retracts quickly to clear the cut, and the fixture automatically indexes to the next position. The programmed sequence of the automatic cycle is interlocked for safety.

Without obligation, we will be glad to analyze your production problems, and make recommendations. Consult Cross to cut cost.



Producing ten gears hourly, this form tool method of gear tooth milling eliminates one drilling and one relief turning operation.

THE **CROSS** COMPANY

Established 1898

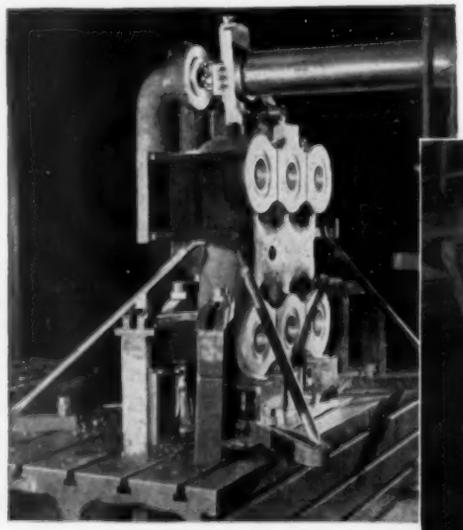
SPECIAL MACHINE TOOLS

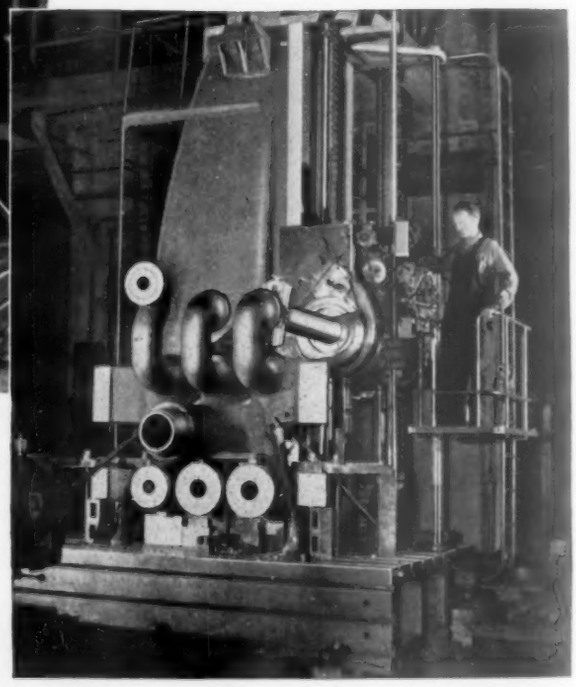
DETROIT 7, MICHIGAN

MILLING • DRILLING • TAPPING • BORING • TURNING • SHAPING • GRINDING • HONING

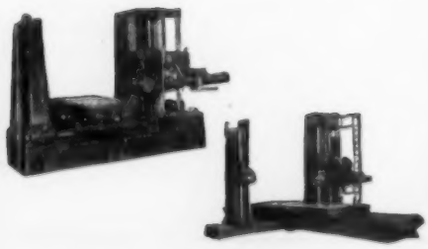
FEWER SET-UPS REQUIRED TO MACHINE THESE LARGE, *odd-shaped pieces* on a G.&L.

Over-all Time Sharply Reduced by Performing Boring, Drilling, Milling and Other Operations in Sequence with Minimum Work Handling

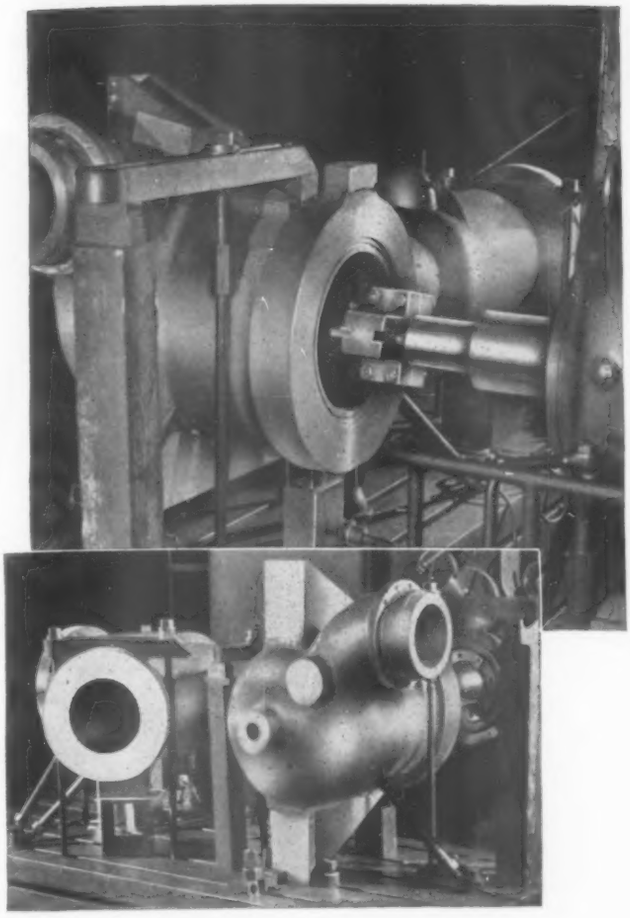




Odd-shaped steam turbine manifold being machined without difficulty on a G. & L.



G&L *Giddings*



LEFT—Boring steam throttle valve port. Several machining operations have already been completed on this part.

LEFT, BELOW—Cast steel two-piece steem throttle valve weldment mounted on box type parallel.

Machining Time Cut from 70 to 50 Hours on Steam Throttle Valve Body

This weldment composed of two steel castings presents an intricate machining problem where a series of milling, drilling, boring, facing and counterboring operations must be performed. The part is both difficult to hold and hard to approach. Open construction of the G. & L. simplifies these two difficulties. Mounting the valve body on a box parallel makes it possible to move the complete unit in any desired position for machining. This simplified handling saves 20 hours over the previous method.

Unusual shaped castings and fabricated parts may be completed faster and more accurately when work settings are reduced to a minimum. Merely by changing cutting tools, numerous boring, drilling, milling, tapping and facing operations are readily performed with the Giddings & Lewis horizontal boring machine. Often many complicated machine components are completed in one setting of the work. Floor-to-floor time is sharply reduced because it is unnecessary to move the work to single-purpose machines and reset it for individual operations.

Submit Difficult Machining and Work Handling Problems to G.&L. Engineers for Recommendations

Experienced Giddings & Lewis engineers are constantly assisting others in solving difficult machining and work handling problems. They are in a position to recommend machines or accessories which will help end job troubles and at the same time produce more parts for you at greater profit. Ask for their help now—there is no obligation.

AVAILABLE FOR YOUR USE...

Free

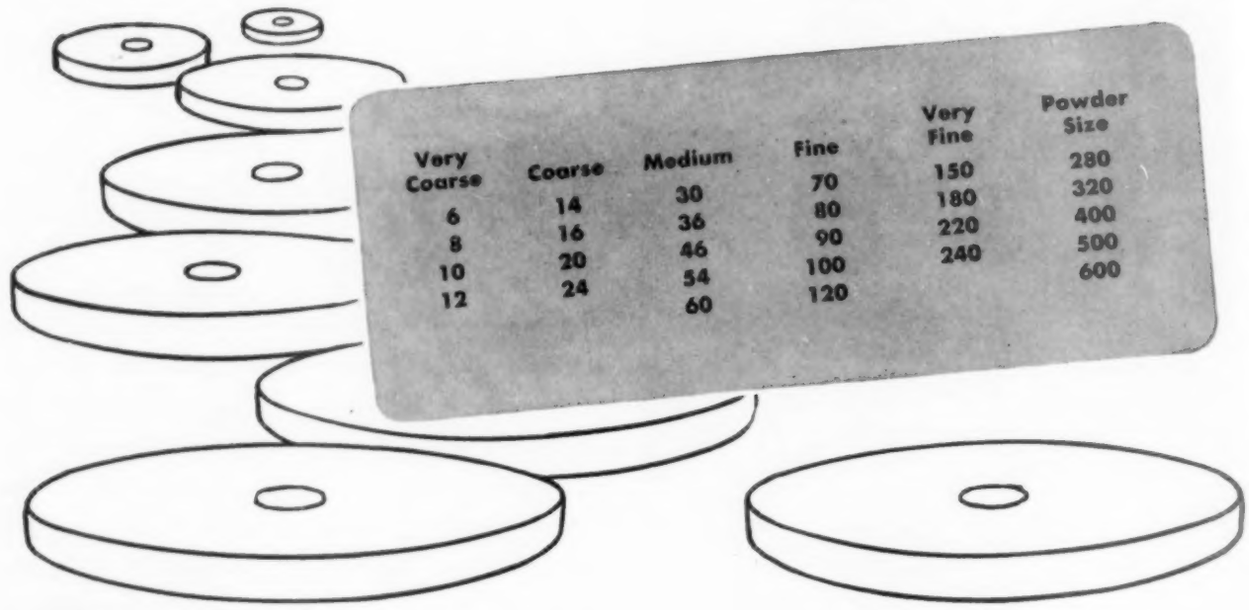
PERFORMANCE INFORMATION

G. & L. machining facts are presented in folder form. Write now for these profitable ideas. Ask for Production Data Folder TE116.

G. & L. MACHINE TOOL CO.

132 DOTY STREET • FOND DU LAC, WISCONSIN

How do you tell which grit to use?



Listed is a commercial classification of standard abrasive grit sizes. They come in a wide range... from 6 classified as very coarse to 600 classified as powder size. And, the variety is further extended by special sizes and combinations. Yet, each one is designed to do a specific job better than any of the rest.

To complicate correct choice even more, there is a long list of variable factors to consider. Among these, you'll find wheel speed, machine condition, specified tolerances, material analysis, related production schedules, and a host of others.

The correct selection hinges on the review which is given to all the controlling factors. Yet...grinding efficiency and economy depend on the right answer.

That's why the Carborundum Company has put together a practical program... a service now deemed essential by many concerns who have been successful in getting improved grinding in terms of better finishes, or at lower cost.

Your nearest contact to this service is a CARBORUNDUM representative You'll find him willing and helpful. Through a sound knowledge of abrasives and first-hand experience of their use and application in the many plants he contacts, he is able to make intelligent recommendations and suggestions. On the more uncommon problems, he can even call on our Abrasive Engineers who are more fully qualified to tackle the tough problems. And, sometimes, the answer comes from the modern laboratories at CARBORUNDUM—where scientists and technicians probe for new information on abrasives, practices and developments.

Here is a sound approach—not only to getting the right grit—but the right combination of grit, bond, grade, structure and all the other parts that make up a grinding wheel. *Plus* knowledge and experience invaluable in modern grinding methods and procedures. It's easy to use. It incurs no obligation. It makes sense. The Carborundum Company, Niagara Falls, New York.

A good rule for good grinding... **CALL IN**

CARBORUNDUM

TRADE | MARK

BONDED ABRASIVES

WHEELS
- Silicon Carbide
- Aluminum Oxide
- Diamond

Cylinder Hones
Sticks, Stones & Rubs
Specialties

COATED ABRASIVES

Paper, Cloth and Combination

Sheets, Rolls, Discs

ABRASIVE GRAINS AND COMPOUNDS

for:

Polishing
Lapping
Pressure Blasting
Finishing

"Carborundum" is a registered trademark which indicates manufacture by The Carborundum Company

Every Tool Room
needs at least one of these sets

GAIRING
Counterbore Sets
provide the cutters and pilots required for ALL counterboring, countersinking and spot-facing operations within their size range. Each of the seven sets, ranging from small to large, contains a logical assortment of interchangeable holders, pilots and cutters neatly fitted into stout wooden cases . . . HOLDERS are furnished with Morse tapers or straight shanks. PILOTS are of selected alloy steel hardened and ground on the head. Shanks are treated to obtain unusual toughness and strength . . . CUTTERS, of high speed steel, are renewable and the sizes selected for sets are of the most active sizes used. Replacements are quickly made from stock.

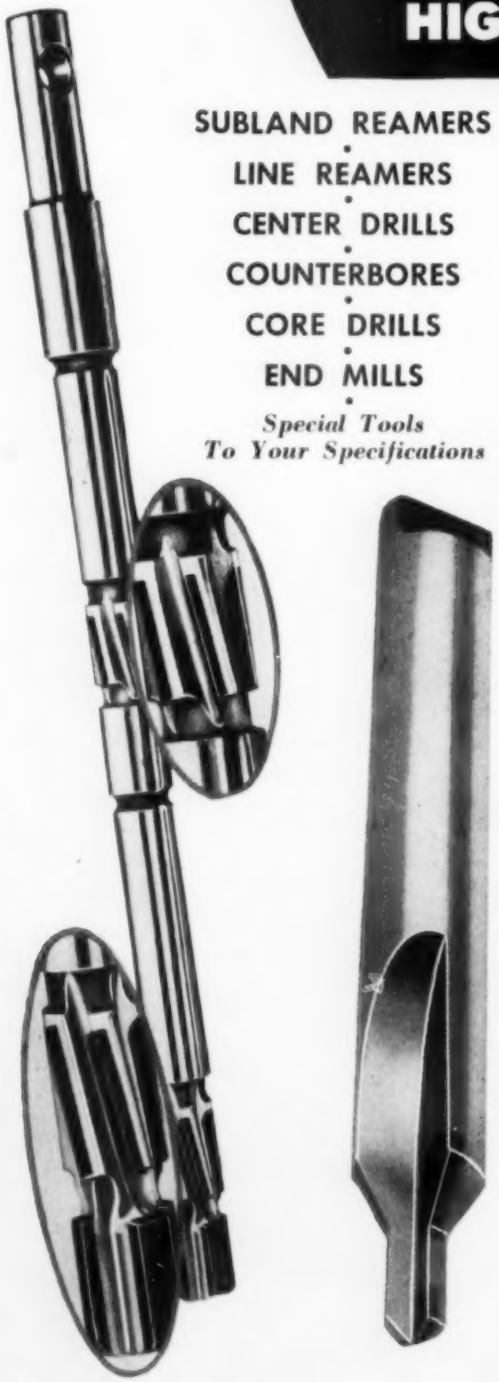
Write today for four-page counterbore folder describing and pricing all seven sets.

THE GAIRING TOOL COMPANY
Roosevelt Park Box 478, Detroit 32, Michigan

GAIRING TOOLS

Now!

CARBIDE-TIPPED TOOLS
BRAZED ON HARDENED
HIGH-SPEED STEEL BODIES



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LINE REAMERS
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CENTER DRILLS
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COUNTERBORES
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CORE DRILLS
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END MILLS
•
Special Tools
To Your Specifications

AGAIN, Detroit Reamer & Tool Company sets the pace in metal cutting tools, with brazed carbide tips on hardened high-speed steel bodies, so that the total length of the flutes and pilots will Rockwell C-62-63.

It has also been proven in actual practice that this type of tool has a higher cutting efficiency due to the harder background for the carbide tips which produces less "spring-back" under heavy cuts for this same reason. Also, the flutes and pilots will not "score" or pick up due to the hardness of the high-speed steel and long wear on the pilot.

All of these outstanding advantages, together with longer tool life and reduced production costs, are at your disposal with Carbide Tipped Cutting Tools, with HIGH-SPEED STEEL BODIES.

• MADE TO YOUR SPECIFICATIONS •

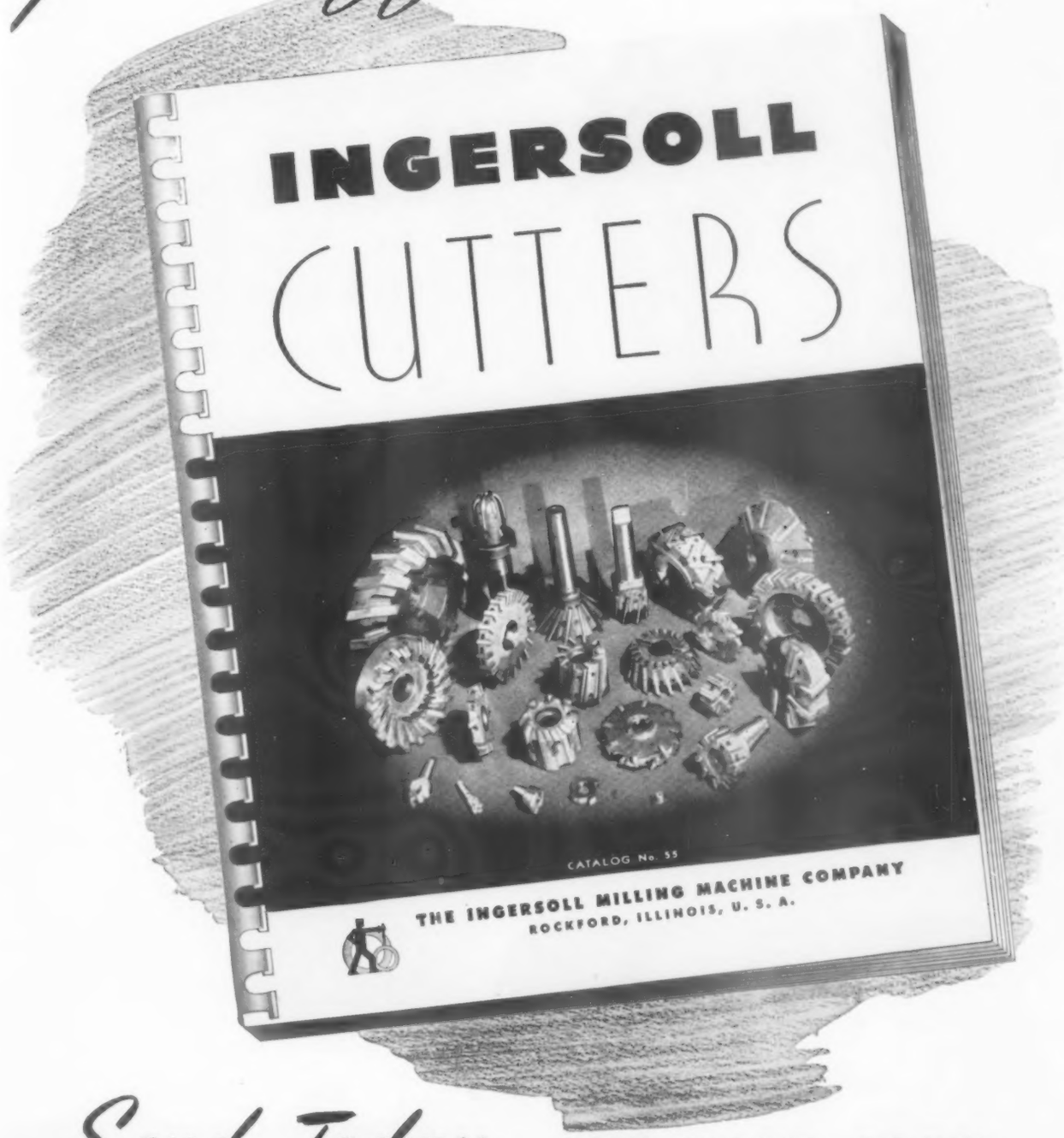
Write for QUOTATION

DETROIT REAMER & TOOL CO.

2830 E. Seven Mile Road **Detroit 12, Michigan**

Manufacturers of Oil-Hole Drills, Subland Drills, Special Reamers, Circularity Relieved Reamers, End Mills and Special Tools

Just Off the Press!



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of this new Ingersoll Cutter Catalog

THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILL.

Builders of Inserted Blade Milling and Boring Tools

GRAND RAPIDS GRINDING MACHINES

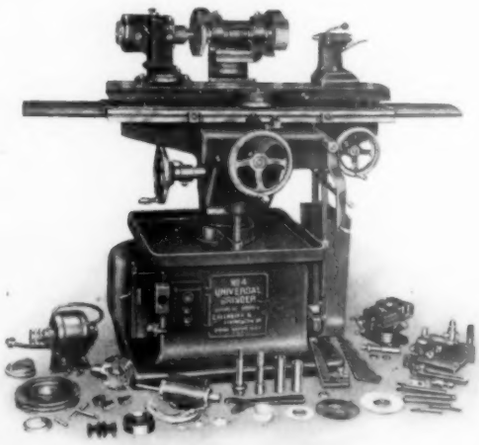
Grand Rapids Combination Tap & Drill Grinder No. 10-B

DELIVER TOP TOOL ROOM EFFICIENCY

Whether you need a Universal Cutter and Tool Grinder or a Combination Tap and Drill Grinder, you can be sure of top tool room efficiency if they bear the name "Grand Rapids," manufactured by Gallmeyer & Livingston Co.

With the Combination Tap and Drill Grinder you save three ways: 1. On first cost, 2. Through lower maintenance expense, 3. On valuable floor space.

With Grand Rapids No. 4 Universal Cutter and Tool Grinder you can handle complex tool grinding jobs with maximum speed and convenience. **Write now** for bulletins 1045 and G. L. 9-15-44.



Grand Rapids No. 4 Universal Cutter and Tool Grinder.

GRAND RAPIDS
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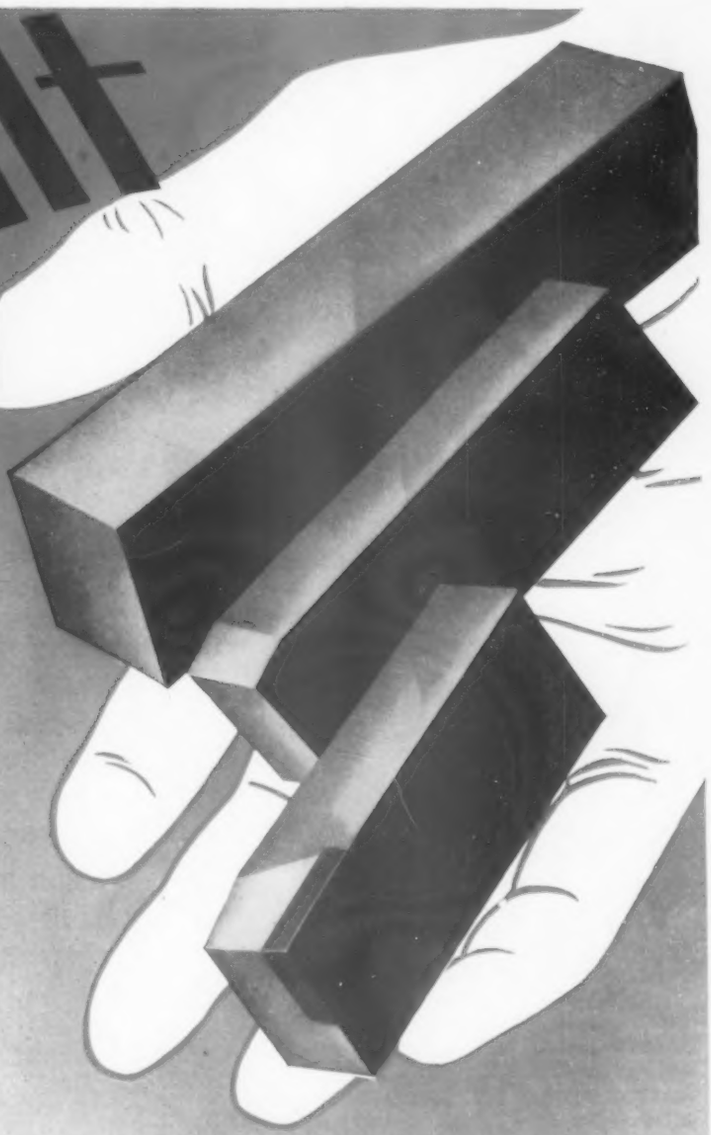
GALLMEYER & LIVINGSTON CO.
GRAND RAPIDS, MICHIGAN, U.S.A.

What "GRAND RAPIDS" Quality Means: Gallmeyer & Livingston cast their close-grained gray iron, machine to micrometric tolerances, precision-assemble grinding machinery of unsurpassed performance. *Grand Rapids* means *top* quality in grinding machinery.

GALLMEYER & LIVINGSTON COMPANY, 110 STRAIGHT ST., S. W., GRAND RAPIDS 4, MICH.

Crobalt Quality



Crobalt is a hard alloy (containing principally chromium, cobalt, tungsten, vanadium, zirconium and carbon), cast in the form of tool bits and inserted milling cutter blades especially developed for high speed production. At high temperatures (up to 2000 degrees) Crobalt cutting qualities remain constant.

The cutting edges of a Crobalt tool stay sharp longer, and thus assure you of much greater tool life between grinds. This automatically increases production by reducing "Down-time" ordinarily required for changing of tools. Try Crobalt in your shop.

CARBIDE TIPPED
Inserted Milling Cutter Blades

Crobalt now fabricates carbide tipped inserted milling cutter blades. Any make of tungsten carbide can be furnished. Prices for this type of blade are unusually low and the product and finish are unexcelled. We manufacture blades of all types and sizes. Send us your prints for quotation.

Crobalt Inc.

1351 N. Main St. Ann Arbor, Mich.

How to get Standard and Special Gages Quicker

STOCK LIST AS OF

5-24-46

DETROIT TAP & TOOL CO.

8432 BUTLER ST DETROIT 11, MICH.
MAdison 0260

SPECIAL TAPS IN STOCK (IMMEDIATE DELIVERY)
RH & LH Taps with ODD PITCHES in both
MACHINE SCREW and FRACTIONAL sizes
STANDARD Taps with UNDER & OVERSIZE
Pitch Diameters

SPECIAL THREAD GAGES IN STOCK (IMMEDIATE DELIVERY)
Large Range of NON-STANDARD Diameters
and Pitches

ST'D TAPS IN STOCK (IMMEDIATE DELIVERY)

ST'D THREAD GAGES IN STOCK (IMMEDIATE DELIVERY)
See pages 2 and 3

On OTHER PRODUCTS SEE TABLE BELOW
for current Delivery Quotations

TOOLS & GAGES	DELIVERIES
SPECIAL THREAD PLUG GAGES	1-2 weeks
SPECIAL THREAD RING GAGES	2-3 weeks
STANDARD TAPS (When not in stock)	2 weeks
SPECIAL TAPS	3-4 weeks
STANDARD THREAD MILLING CUTTERS (From Stock Blanks)	1 week
SPECIAL THREAD MILLING CUTTERS (Natl. Form)	3-4 weeks
SPECIAL THREAD MILLING CUTTERS (Spec. Form)	4-5 weeks
THREAD CHASER BLADES	3-4 weeks
MACHINES	
TAP RECONDITIONERS	2-3 weeks
LIGHT DUTY TAPPING MACHINES	2-3 weeks
HOB HOOK & SPACING CHECKER	4-5 weeks

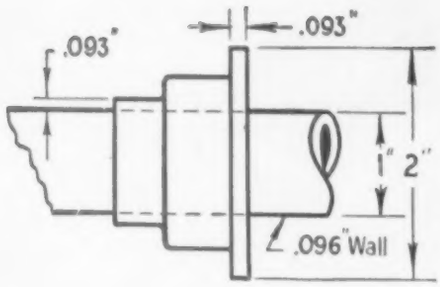
BALTIMORE 21, Md.....ESsex 2366
BIRMINGHAM, Ala.....Birmingham 7-1017
BOSTON 16, Mass.....LIberty 9398
BUFFALO 2, N. Y.....GRant 6601
CHICAGO 12, Ill.....KEdsie 3170
CINCINNATI 2, O.....MAin 2544
CLEVELAND 13, O.....CHerry 3520
DAYTON 2, O.....FUlton 6161
DENVER, Colo.....KEystone 7229
DETROIT 11, Mich.....MAdison 0260
FLINT, Mich.....Flint 4-2624
HOUSTON 2, Tex.....FAirfax 1426
INDIANAPOLIS 9, Ind.....FRanklin 2456
LOS ANGELES 37, Calif.....ADams 1-4381
MILWAUKEE 2, Wisc.....DAily 4256
MUSKEGON, Mich.....MUskegon 248
NASHVILLE 6, Tenn.....Nashville 6-3647
NEWARK 2, N. J.....MArket 3-1493
PITTSBURGH 19, Pa.....ATlantic 3011
PORTLAND, Ore.....VErmont 2334
ROCKFORD, Ill.....MAin 2243
ST. LOUIS 1, Mo.....CEntral 4435
SAN FRANCISCO, Calif.....DOuglas 7711
SEATTLE 9, Wash.....MAin 6427
SOUTH BEND 3, Ind...South Bend 3-0009
SPOKANE 8, Wash.....MAin 2191
SYRACUSE 9, N. Y.....SYracuse 8-1462
TOLEDO 4, O.....GArfield 8302
MONTREAL, Canada.....MAin 5346
TORONTO, Canada.....WAverly 2688
WINDSOR, Canada.....Windsor 4-9239

The quickest way is to call the Detroit Tap representative in your area. He has readily available up-to-the-minute stock lists of Detroit thread plug and ring gages. You can obtain a copy immediately and a revised copy every two weeks by phoning him today.

DETROIT TAP & TOOL CO.

8432 BUTLER AVE. • DETROIT 11, U.S.A.

How "Job-Rating" can improve YOUR designs!



TYPICAL JOB

Assemble and join thin mild steel stampings and tube to resist torque, compression and shear.
No distortion or surface marking permissible on tube.
Total units required—50,000
Production required—1200 per 8-hr. day

JOB-RATING

METHOD	BEST OUTPUT	MAX. STRENGTH	MIN. FINISHING REQUIRED	LOWEST COST PER PIECE
SPOT WELD	1	1	1	1
ARC WELD		2		2
TORCH WELD				
SOLDER (TORCH)			2	
FURNACE BRAZING	2			

List possible joining methods and controlling factors, as above.
Rate the methods 1, 2, for each design factor.
Select the best method. Check your design with this method in mind.

ANALYSIS

Watch resistance welding come up No. 1 on every count! This example shows over 70% savings for spot welding over the second best method, in labor costs alone. In addition, strength is "tops". There is no distortion. Output is far ahead of other methods. Only design factor involved is to make sure there is room on the sleeve for the spot welds. Your analysis may also show similar advantages for resistance welding in a vast majority of assembly problems. 'Progressive' machines, such as the spot welder at left, prove that it pays to weld on job after job.

"SEE US AT THE METALS SHOW" BOOTH J-220

IT PAYS TO WELD

For news of the latest developments in resistance welding equipment and methods, influencing product design, ask to be put on the mailing list for the Progressive "WELDING PICTORIAL".

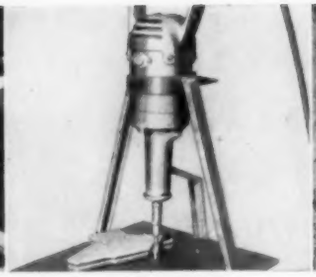
MEMBER RESISTANCE WELDER MANUFACTURERS' ASSOCIATION RWMA

PROGRESSIVE Welder Co. 3050 E. OUTER DRIVE • DETROIT 12

RESISTANCE WELDING EQUIPMENT

DUMORE
No. 9 HG
¼ HP — 15,500 RPM
¼" capacity chuck

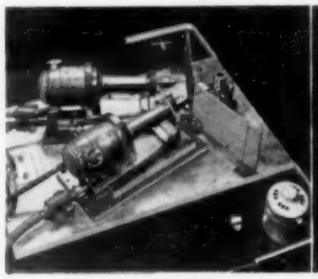
Cleaning Welded Joints



Contour Milling Hard Copper

Spark-Testing Steel

DUMORE
No. 10 HG
1/10 HP—22,000 RPM
⅛" capacity chuck

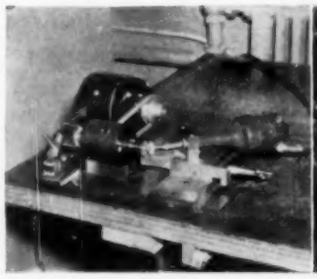


Automatic Drill Head

Touching-Up a Forging Die

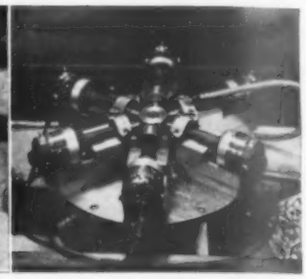
De-Burring Gear Teeth

DUMORE
No. 8 HG
1/20 HP—18,000 RPM
⅛" capacity chuck



Automatic De-Burring Unit

Finishing Plastic Mold



Automatic Hex-Screw Drilling Unit

YOU can do an endless variety of jobs with a sturdy, serviceable Dumore Handgrinder

Its rugged durability guarantees efficient, trouble-free service

When you have a job that requires a good handgrinder, select a Dumore. Grinding is only the first of many jobs you can do with these versatile tools. They have scores of other applications (a few illustrated on this page) — polishing, finishing, sanding, burring, scoring, touching up, drilling, milling, and many more.

Dumore Handgrinders are more than just hand tools. Many ingenious users have built special machines in which the work heads are one or more Dumore Handgrinders. Such machines are reliable, low-cost production units requiring minimum maintenance attention.

Dumore Handgrinders are sturdy tools — designed to give long and dependable service — built to stand up under the constant strain of heavy production schedules.

You can find many spots in your plant where service difficulties can be eliminated, production simplified and speeded up, by using Dumore Handgrinders. Ask your nearby distributor to recommend the right size for your needs. Write for complete information. The Dumore Company, Racine, Wisconsin.

TEAR OUT AND MAIL COUPON TODAY!

FREE — Catalog 42

THE DUMORE COMPANY, Dept. K-43, Racine, Wisconsin

Please send without obligation, Catalog 42, describing your complete line of tools and grinders.

Name.....Position.....

Company.....

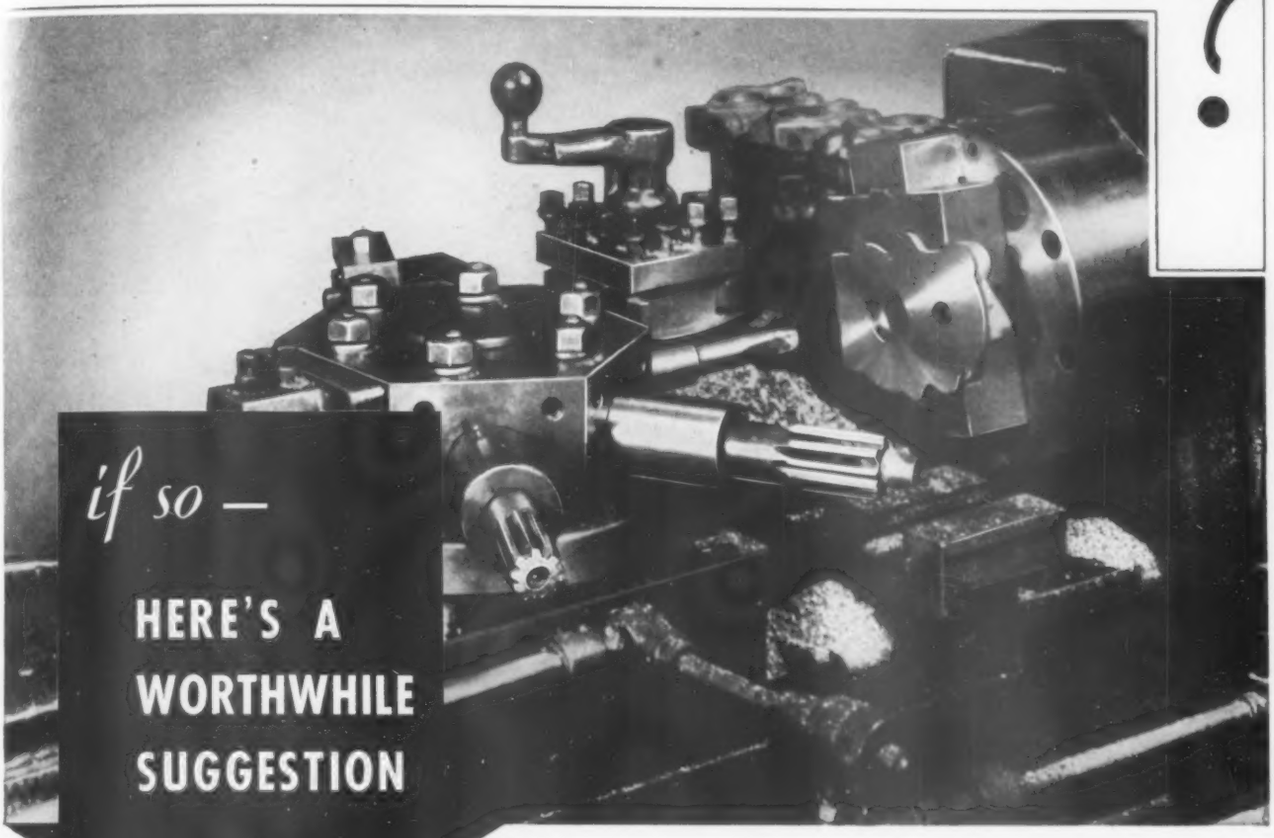
Address.....

City.....(.....) State.....

DUMORE
PRECISION TOOLS

Sold by leading industrial distributors in all principal cities

Are you concerned with *heavy duty* turret lathe operations ?



if so —

HERE'S A WORTHWHILE SUGGESTION

Cushman Heavy Duty and Extra Heavy Duty Chucks, designed and built "from the ground up" especially to meet the demands of modern turret lathe operation are equipped with American Standard 2-piece jaws and Serrated 2-piece jaws respectively. The construction of these precision chucks fully qualifies them for continuous service under heavy feeds and at high speeds with carbide tools. The two piece jaw equipment permits the use of formed soft blank top jaws...at a cost far below that of special jigs or set-ups...when irregular shaped work pieces are being machined. It is likewise easy and economical to change from one set of jaws to another without dismounting the chucks.

Whether your needs in work holding equipment are "standard" or "special" Cushman can supply a cost saving answer out of the long experience of our Engineering Department. Call upon us without obligation.

THE CUSHMAN CHUCK COMPANY • Hartford 2, Connecticut

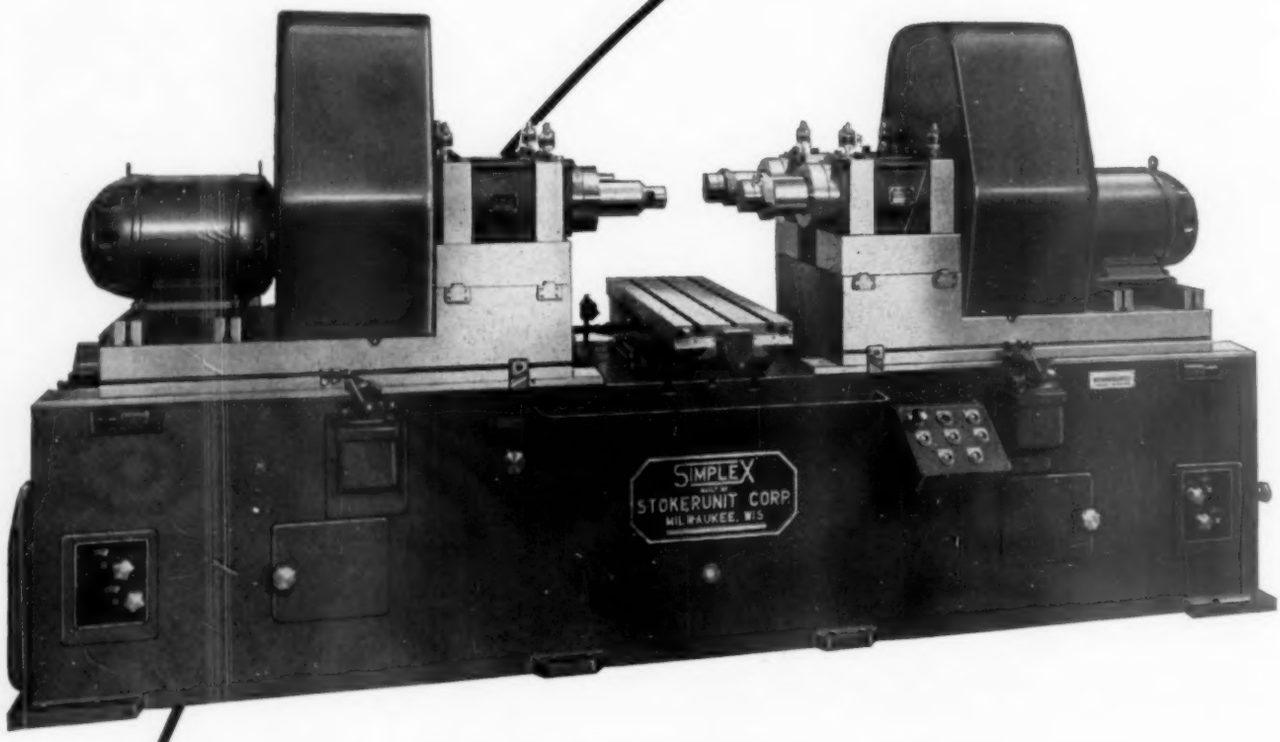
A WORLD STANDARD FOR PRECISION

CUSHMAN CHUCKS

You can depend upon your Cushman Distributor for expert, experienced assistance in the solution of your work holding problems. Call on him.

SIMPLEX

Increasing wage rates of today make necessary new methods of reducing costs. At medium production rates, this becomes difficult with general purpose machine tools. Simple multiple tooling and fixtures, indexing from roughing to finishing position, offer a new cost reduction method. Tooling costs are low — job possibilities endless.



This photograph shows a SIMPLEX 4U 2-way Precision Boring Machine equipped with four #4 spindles and a hydraulically indexed sliding table operating between adjustable positive stops. On the sliding base a single work holding fixture is mounted providing for operating on the work from both ends. After the roughing operation is completed on both ends, the table is indexed to the finishing position, the finishing operations are performed on both ends simultaneously and the completed job is ready to remove from the fixture to change to the next job. The fixture and tools are removed and retained intact, ready for a quick set-up when the job is again run. The automatic cycle relieves the operator and helps maintain predetermined production schedules.

Precision Boring Machines

STOKERUNIT CORPORATION

SIMPLEX Machine Tools Division

4528 West Mitchell Street, Milwaukee 14, Wisconsin

Precision Boring Machines, Planer Type Milling Machines and Special Machine Tools

IT'S NEW-DIFFERENT

"American"

V-EIGHT GRINDING WHEEL

SPECTACULAR IN ITS COOL, FAST CUTTING

The new "American" V-Eight Wheel takes heavy cuts and holds its corners — is an excellent performer in dish and cup shapes. Its structure gives maximum air cooling for dry grinding . . . carries extra coolant when wet grinding. The V-Eight removes more metal in less time and gives long, efficient service both on production jobs and in the tool room.

Write for information.

ENTHUSIASTIC USERS TELL US . . .

- Wonderful wheel. Took .012" cut on hard steel, Rockwell 60C, without loss of corner.
- Made .015" cut on soft tool steel die holder without difficulty; stepped up cut to .030" and wheel still did a good job.
- Only wheel that would do the job on Hi-chrome die steel.
- Took .040" cut on oil-hardened tool steel without excessive heat or breakdown.

LET THE NEW V-EIGHT WORK FOR YOU!

AMERICAN EMERY WHEEL WORKS

ESTABLISHED 1898

15 RICHMOND SQUARE, PROVIDENCE 1, RHODE ISLAND

THESE NICKEL CAST IRON EXTRUSION PUNCHES..

Performed 12 times better than those of plain gray cast iron . . .

Machined extrusion punches of Nickel alloyed iron.* Wyman-Gordon use these punches in a 1500-ton press for making extrusions of Type 2512 Steel (5% Nickel) at a forging temperature of 2250° F. These punches measure about 10" long and 4" in diameter.

*Produced by HUNT-SPILLER MFG. CORP. South Boston, Mass.

Metal used for extrusion punches must be *tough* to resist breakage, *strong* to resist deformation, and *resistant* to heat effects involving checking, scoring and roughening.

Proper alloying with Nickel, along with chromium and molybdenum, results in cast irons that meet these rigid requirements.

The table below shows some of the data obtained from extensive tests made by The Worcester, Mass. Division of the Wyman-Gordon Company, a leading producer of aircraft forgings.

Extrusion punches provide just one more illustration of important advantages gained by using Nickel cast irons. In addition to their longer life of useful service Nickel irons can be conveniently cast and easily machined . . . thus effecting obvious economies. Our casting specialists will be glad to consult with you and suggest where Nickel Alloy Irons may be useful to you.

The low strength of unalloyed gray iron was responsible for this typical failure by fracture at root of stud recess after a short service life.

COMPOSITION AND SERVICE LIVES OF GRAY CAST IRON EXTRUSION PUNCHES

No.	TYPE	CHEMICAL COMPOSITION										Range of Lives	Average Life	B.H.N.	Type of Failure
		T.C.	G.C.	Si	Mn	P	S	Ni	Cr	Mo	Cu				
1	Unalloyed	3.16	2.48	1.85	1.08	.22	.10	.80	.12	.02	.05	3-143	38	207-217	Broke
2	Mo	3.10	2.50	1.88	1.12	.18	.06	.80	.15	.28	trace	13-399	122	223-228	Broke
3	Cu-Cr-Mo (Intermediate Phos.)	3.05	2.05	1.75	1.20	.24	.07	.08	.65	.45	1.50	2-56	28	217-241	Broke
4	Cu-Cr-Mo (Intermediate Phos.)	2.92	2.08	1.82	.96	.20	.09	.00	.46	.44	1.50	8-352	186	202-228	Broke
5	Ni-Cr-Mo (Low Phos.)	2.82	2.02	2.26	.86	.09	.08	1.85	.28	.71	trace	45-774*	311	228-240	Bent, Roughened or Broke
6	Ni-Cr-Mo (Low Phos.)	2.60	1.91	2.13	.64	.13	.07	2.28	.21	.78	trace	42-1370†	470	228-240	Bent, Roughened, Broke or Stud Pulled Out

*11 castings failed after making less than 240 forgings. 5 castings made more than 450 forgings. All others between 240 and 450 forgings each. †7 castings failed after making less than 240 forgings. 3 castings made more than 1000 forgings. All others, 240 to 1000 forgings.

EMBLEM OF SERVICE INCO Nickel TRADE MARK

Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of alloys containing Nickel. This information and data are yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

When you're figuring ways to get more production from present machines, here's something to think about:

You can increase production in such operations as drilling, tapping, reaming, milling, etc., from 40% to 500% by replacing manual feeding with Bellows Senacon "controlled-air" power feeding.

Bellows Senacon Feeds are inexpensive to buy, inexpensive to install. Precision controls provide correct feeding rates, power thrusts, etc., for almost any tool, working in almost any material.

Write today for Bulletin DF-100R.

USERS REPORT . . .

"One operator runs two drill presses. Increased production from 800 to 2000 per hour."

"Inexperienced operators more than doubled production on end milling operation."

"One Bellows Senacon feed operates two spindles with third spindle fed by hand. One operator for all three spindles. Production tripled."

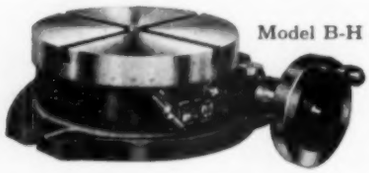
"Bellows Senacon feed increased production on one tapping operation from 300 to 750 per hour, virtually eliminated operator fatigue."

Bellows Senacon Co.

798 N. MAIN STREET • AKRON 10, OHIO

TOOLS for PRECISION PRODUCTION

ROTARY TABLES



Model B-H 12

A useful addition to any shop doing a variety of work. Often takes the place of a costly fixture.

- UNIVERSAL — With the exception of Model BH-9, all tables are so designed that a dividing attachment may be purchased at any time after table is in use.
- THROWOUT WORM—May be disengaged easily. Re-engaging it does not throw it out of adjustment.
- HANDWHEEL—Is shaped to fit the hand—quick action type.
- GRADUATIONS—Are cut on a special graduating machine. Degrees are indicated on the platen, minutes are on the dial.

Rotary table may be used for work on milling machines, shapers, drill presses and horizontal boring mills.

MAGNETIC BLOCKS

FOR SURFACE GRINDERS

$14.50 SET Net

This universal set consists of two parallels 1" x 1¾" x 3¾", and two V-blocks 1¾" x 2⅜" x 1⅞". This set has been especially designed for holding various types of work that cannot be placed directly on the magnetic chuck. Complete in Hardwood Case.

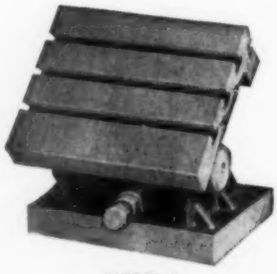
ADJUSTABLE

ANGLE PLATES

For Machining and Grinding Angles

These Angle Plates are made of the best grade of gray iron, machined and ground true with the holes, all steel parts are hardened and ground.

MODEL "A" has four 3/16" "T" SLOTS, 3 on the face side and one "T" Slot on the top when set at 90°. The size of this plate is 3 x 3 x 3¾. Shipping weight 5 lbs.



MODEL A

Net Price $14.40

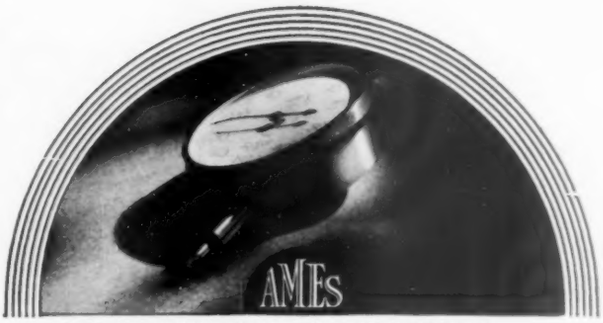
PROMPT DELIVERY

Write for Literature

PRECISION PRODUCTION TOOLS

ACME TOOL COMPANY

96 WARREN STREET • NEW YORK 7, N. Y.



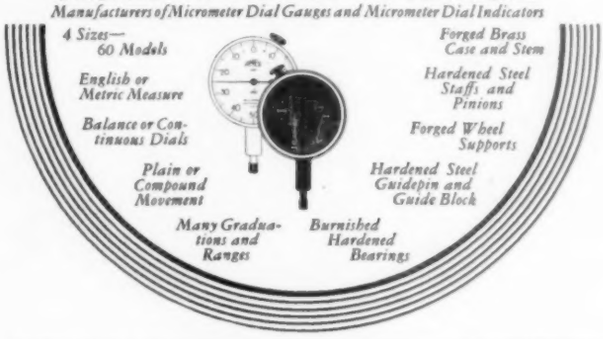
FOR MILLIONS of READINGS . . .

Insist on sensitivity, accuracy and long life in Dial Indicators—the kind that AMES has been making for 50 years.

Many features of AMES design are exclusive. Only the best materials are used. Add expert craftsmanship and you have AMES Indicators that will outlast any you can buy—at any price. Send for illustrated Catalogue.

Representatives in principal cities **B. C. AMES CO.** *30 Ames Street Waltham 54, Mass.*

Manufacturers of Micrometer Dial Gauges and Micrometer Dial Indicators


4 Sizes—60 Models
English or Metric Measure
Balance or Continuous Dials
Plain or Compound Movement
Many Graduations and Ranges
Burnished Hardened Bearings
Hardened Steel Guidepin and Guide Block
Forged Wheel Supports
Hardened Steel Staffs and Pinions
Forged Brass Case and Stem

ARMSTRONG

CUTTER SERVICE

Whatever the cutting speed you need, no matter what the material to be machined, the ARMSTRONG System of Tool Holders provides correctly designed ARMSTRONG TOOL HOLDERS and cutters of proper type for the job.

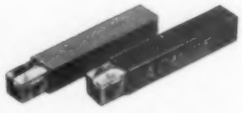
For ordinary machining at the speeds indicated, we recommend:

up to **150 f.p.m.**

ARMSTRONG HIGH SPEED Bits, Blades or Cutters in standard ARMSTRONG TOOL HOLDERS.

up to **300 f.p.m.**

ARMALLOY (cast alloy) Bits and Blades in ARMSTRONG *CA* TOOL HOLDERS.



up to **600 f.p.m.**

ARMIDE (Carbide-Tipped) Cutters in ARMSTRONG *Carbide* TOOL HOLDERS.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

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Eastern Warehouse and Sales Office
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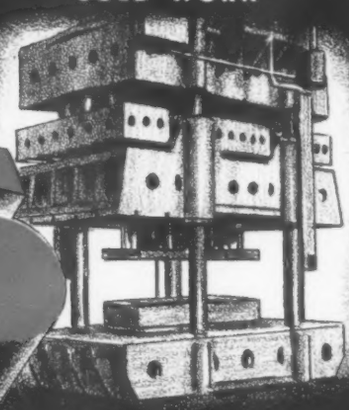
Peninsular's BROWN LABEL Tool Steel

FOR YOUR GENERAL PURPOSE

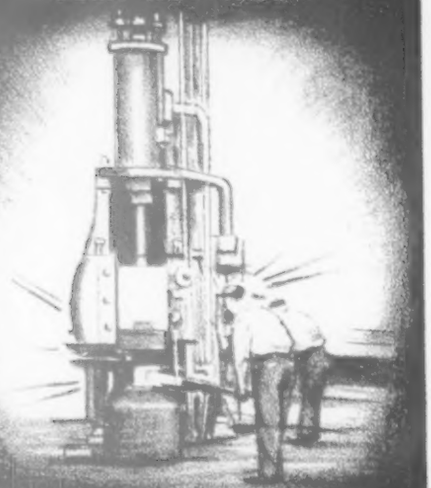
ANALYSIS	
Carbon	.50
Silicon	.75
Mang.	.20
Chromium	1.10
Tungsten	2.50
Vanadium	.15

COLD WORK



Punching, Coining, Blanking, Forming and Roll Thread Dies, Cold Heading, Pneumatic Tools, Rivet Sets, Shear Blades, Master Hobs.

SEMI-HOT WORK



Forging Inserts, Hot Header Dies, Piercers.

Extra Performance and Economy WITH THIS HEAVY DUTY, SPECIAL OIL HARDENING TOOL STEEL

A steel that gives extra performance and economy in its non-deforming characteristics with safe hardening. Superficial surface hardness is obtained by pack hardening with a tough back-up core. It is an inexpensive Tool Steel for very tough cold work applications, whether they be blanking or forming, and where extreme high temperatures are not used. Brown Label will withstand shock, pressure and hold thin, sharp edges.

Brown Label's chemistry was determined only after years of research and actual service. If you have a tough job coming up, use Peninsular's BROWN LABEL . . . there is none better! Write or call for our new catalog.

The PENINSULAR STEEL Co.

CHerry 7173 2222 Lakeside Avenue, Cleveland 14 Emergency Phone—LAkewood 1133

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DETROIT 7: 1040 McDougall Ave. AKRON 11: 915 Miami St. CHICAGO 12: 122 S. Damen Ave.

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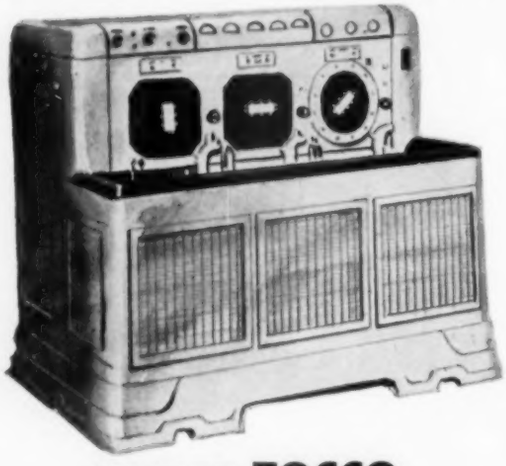
ERIE: Industrial Metals & Products Co., 934 W. 9th St. ROCKFORD, ILL.: Rockford Industrial Supply Co.

FOR A BETTER JOB

MODERN INDUCTION HARDENERS



MADE BY TOCCO
PRICED FOR QUICK SALE

A large number of TOCCO induction heating furnaces, used and unused, are now available for immediate sale. These are late developments in controlled surface hardening by high frequency induction. The furnaces are designed to give selective and uniform hardening—cut costs—boost output—save space—fit easily into your production line.

It will definitely pay you to consider the use of this equipment for your surface hardening requirements. All items subject to prior sale.

SPECIFICATIONS:

9600 cycles; 1, 2, or 3 station 220/440 volt, 3-phase, 60 cycle, range 7½ to 125 KW; and 200 KW machines at 3000 cycles.

Use this coupon to obtain complete information on the machine you want. Simply mail it to your nearest W.A.A. Regional Office.

TO WAR ASSETS ADMINISTRATION:

Please send me, without obligation, full information on the price, location and condition of Induction Heating Equipment of the following types:

.....

.....

Name .....

Firm .....

Address .....

City ..... State .....

Although this material has previously been offered to priority claimants, 10 per cent of the merchandise has been reserved to fulfill any further needs of priority claimants including VETERANS OF WORLD WAR II who are invited to contact the Regional Office serving their area.

EXPORTERS

The War Assets Administration solicits your inquiries. Communicate with your foreign clients promptly.

WAR ASSETS ADMINISTRATION

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Offices located at: Atlanta • Birmingham Boston • Charlotte • Chicago • Cincinnati Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville Kansas City, Mo. • Little Rock • Los Angeles Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha Philadelphia • Portland, Ore. • Richmond St. Louis • Salt Lake City • San Antonio San Francisco • Seattle • Spokane • Tulsa

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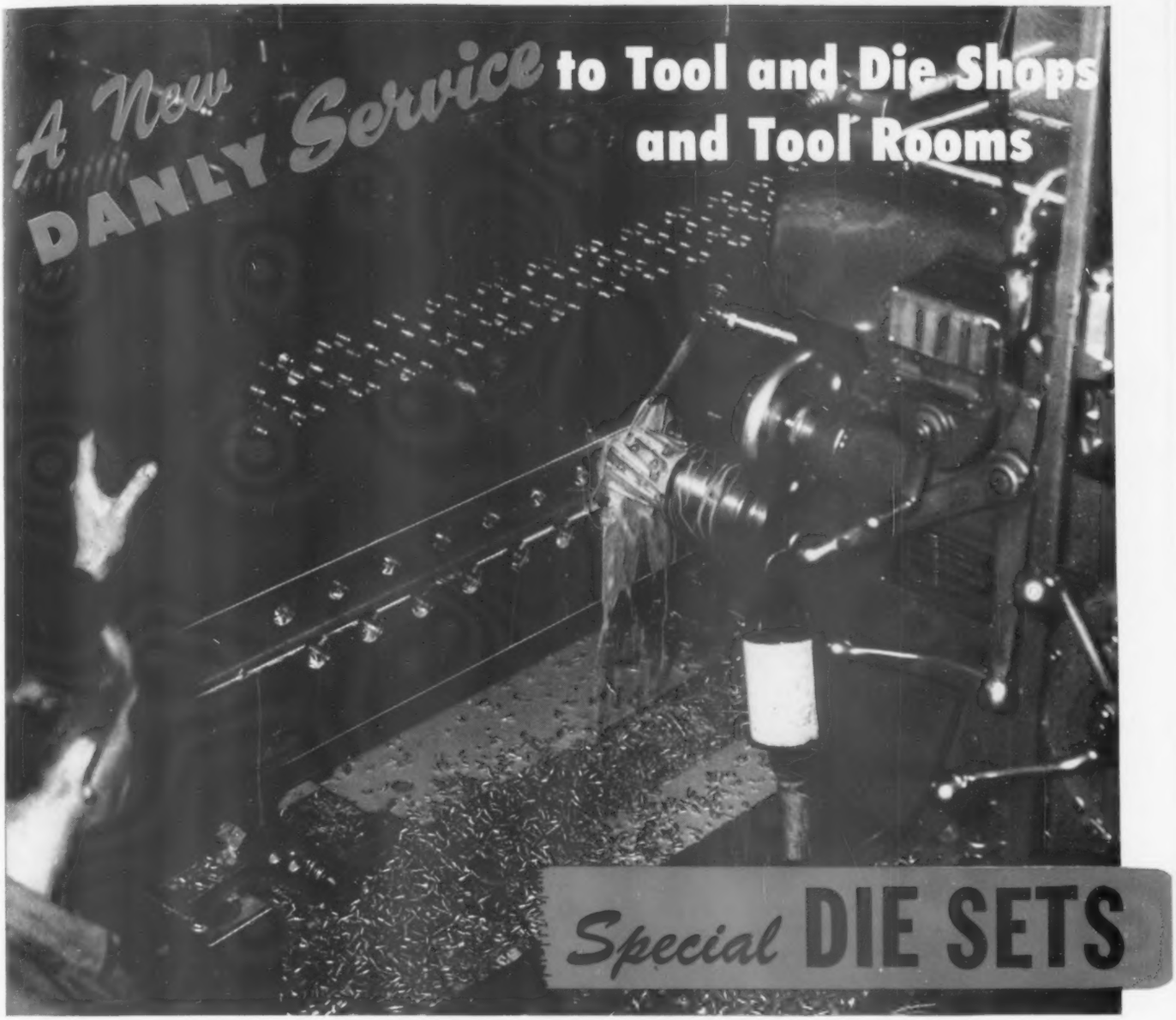

with any special machining required

So many customers have requested additional machine work on special die sets, that such service is now made generally available.

Complete equipment is installed to do any desired machine work to the customer's specifications on any special die set made by this company including M-K & A-S sets, as listed in general catalog.

These special die sets may now be delivered completely machined ready for the mounting of the die. This service saves time, as the work on the die and the die set can proceed simultaneously.

It permits the die shop or tool room to devote their equipment and man hours to the making of dies.

This service also solves the problem of the handling of big sets, for which the die shop or tool room may not have the machining or handling equipment to perform the necessary work economically.

We would like to know what you think of this new Danly Service to the tool and die shops and tool rooms of America. On your next special die set inquiry include the additional machining work that you believe could be advantageously handled "on the outside." The cost of such machining will be shown as an individual item in the quotation.

DANLY MACHINE SPECIALTIES, INC.

2100 South 52nd Avenue • *Chicago 50, Illinois*

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Detroit 16.....1549 Temple Avenue
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Ducommun Metals & Supply Company
4890 South Alameda, Los Angeles 7

DANLY *Special* DIE SETS

Hanna *Control Valves*

for efficient control of air and hydraulic cylinders

. . . Hanna Unitite Junior ¼" Control Valves

These Unitite Juniors have the same functional design as the well-known Hanna Unitite Valves. Designed as 4-way valves, they can be used as 3-way valves by plugging one port. Unitite Junior Control Valves are suitable for air, oil or water pressures to 250 p.s.i. The handle movement is 80° for complete reversal.

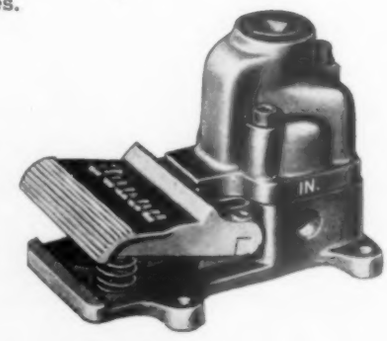
Precision built, packless and permanently tight, Unitite Juniors are ideal for operating small pneumatic or hydraulic cylinders or as pilot controls for larger valves. Available in 3 mounting styles. *Write for literature.*

. . . Hanna two-direction Speed Control Valves

This valve installed between the operating valve and one end of a cylinder provides adjustable control of inflow as well as outflow of the air or oil independently to and from one side of the piston.

One valve will therefore control the piston speed in two directions. One valve is always sufficient for oil operation, but when most effective control of an air cylinder is desired, two valves, one for each end of the cylinder, are used.

Hanna Speed Control Valves are made for working pressures of 250 pounds for air cylinders and 1,000 pounds for hydraulic. Available in ¼", ⅜", ½", ¾" and 1" pipe sizes. *Write for literature.*



. . . Hanna foot operated Valves

Hanna Foot Valves provide quick, almost effortless control —free hands for holding work, feeding or removing pieces, and all the other things that hands alone must do. Consider Hanna Foot Valves wherever possible. They will speed work, increase efficiency, reduce operator fatigue. Soundly designed for foolproof operation, sturdily built of quality materials—Hanna Foot Valves will prove a worthy part of any machine or operation where they are used. Available in single and double pedal models in ⅜", ½", ¾" and 1" pipe sizes. *Write for literature.*

Hanna Engineering Works

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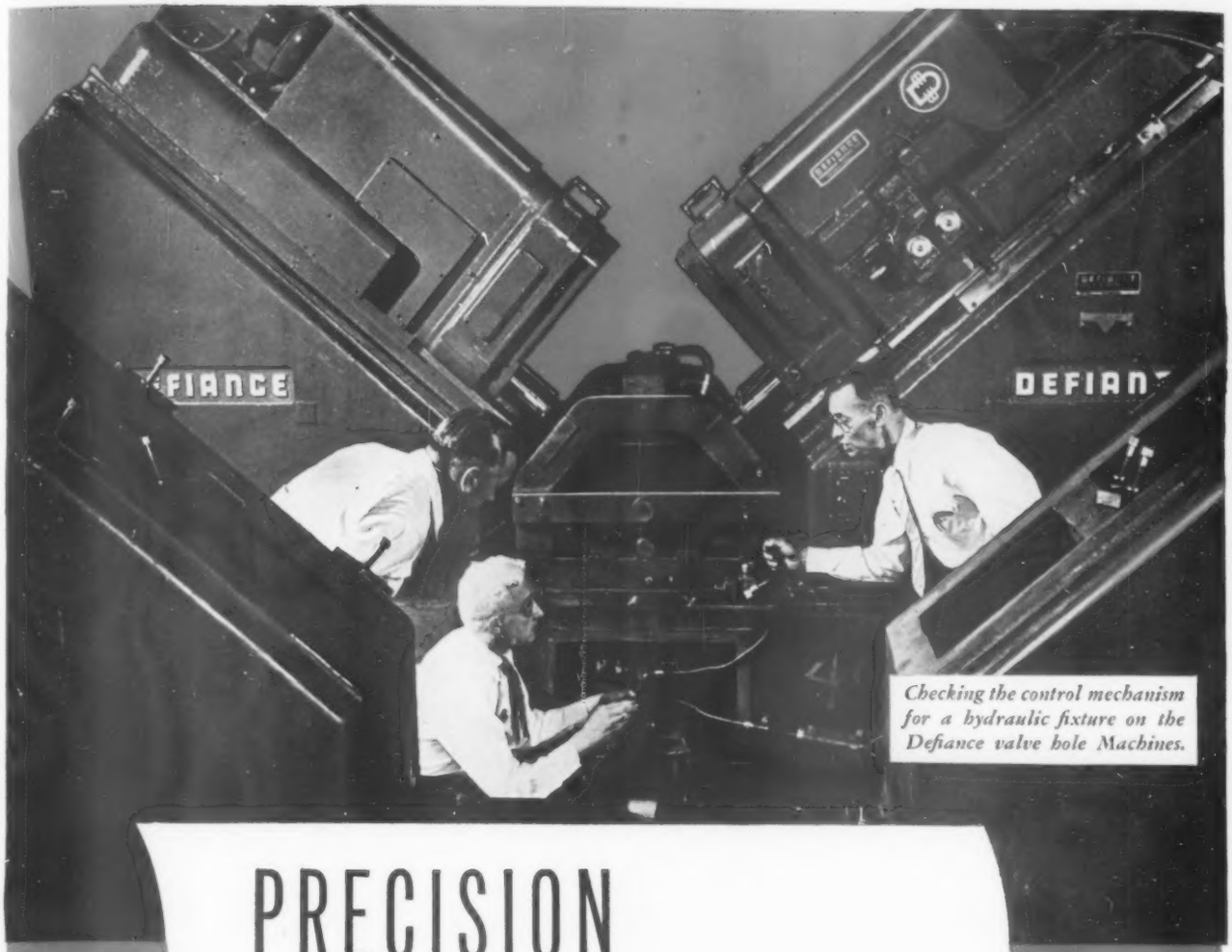


Checking the control mechanism for a hydraulic fixture on the Defiance valve hole Machines.

PRECISION

. . . IN PRODUCTION MACHINING ON V-TYPE MOTORS

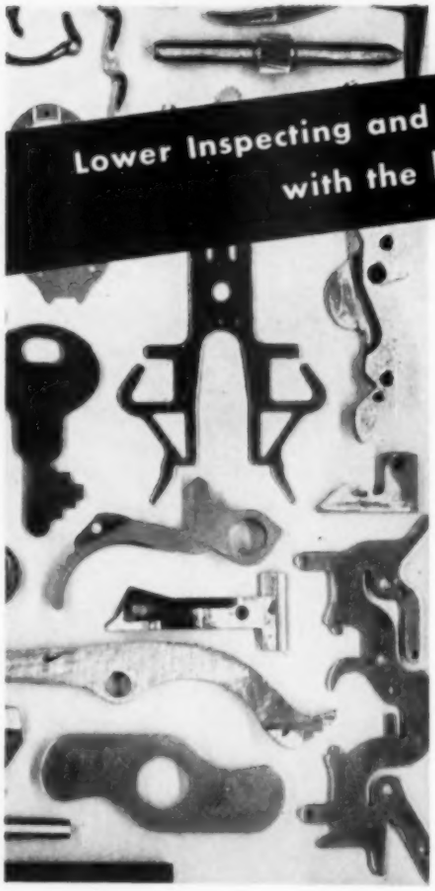
Eight of these Defiance Machines in a series handle machining of valve holes and inserts in the manufacture of V-type motors. A job demanding *accuracy* in a difficult set-up!

The machines are No. 37 hydraulic units . . . mounted in pairs on columns at proper angle . . . tunnel type fixture with locating pins and clamping arrangement hydraulically operated and automatic. The first machine in the series has 8 spindles — the others, 16 spindles each. Sequence of operations is as follows: machine valve chambers and rough cut the counterbore for inserts . . . rough bore tappet holes and valve guide hole . . . semi-finish valve guide and tappet holes . . . machine valve clearance and semi-finish insert counterbore diameter . . . fly cut valve guide and tappet holes . . . line ream insert counterbore, valve guide and tappet holes . . . rough cut valve seats of inserts . . . finish cut seats of inserts.

Whatever your problem in boring—milling—drilling . . . consult with Defiance. Get *precision and efficiency* to improve quality and cut costs! Write . . . Defiance Machine Works, Inc., Defiance, Ohio.

DEFIANCE

96 YEARS OF PRECISION MANUFACTURING



Lower Inspecting and Measuring Costs on Parts Like These with the Bausch & Lomb CONTOUR MEASURING PROJECTOR

How do you measure, compare, and inspect machined parts? Have you checked your methods with advantages of the Bausch & Lomb Contour Measuring Projector?

This versatile, precise, optical instrument provides a modern method that is simple, economical, and fast. It projects a sharp, distinct, geometrically true, magnified silhouette of the object. Dimensions, angles, and profiles may be compared directly with a large scale drawing superimposed on a plain screen. By utilizing a protractor screen, all angular measurements can be made to ± 1 minute of arc (1′)—an accuracy not available with any other projector. Also, direct measurements, accurate to ± .0001″, may be made by means of the cross slide stage with its attachments.

Many manufacturers are using the Bausch & Lomb Contour Measuring Projector to make more precise products in less time, at lower cost. Write for Catalog D-27. Bausch & Lomb Optical Company, 763-11 St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB

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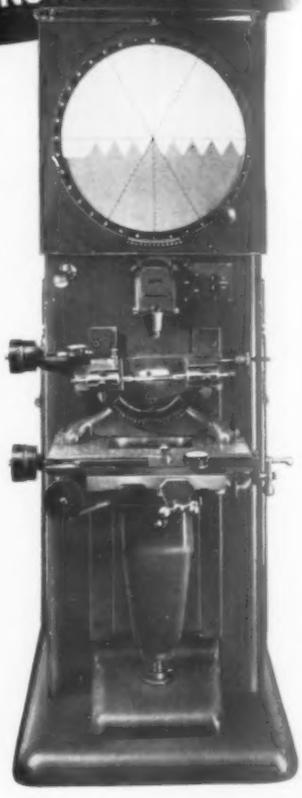

TRADE MARK

ALLEN

SOCKET HEAD CAP SCREWS

This picture suggests why tooling jigs call for ALLEN Socket Head Cap Screws almost universally. (This view is from the toolroom of the Douglas Aircraft Company, Inc., in Santa Monica, California.)

"Allens" have the *clamping-power* for the firmest of set-ups. Their strength is gained by *pressur-forming* of special-analysis ALLEN-OY steel, which makes the steel fibres conform to the shape of the screw head. In the perfectly-formed hex sockets, the keys bear evenly and equally on all surfaces. Threads are also *pressur-formd* to a high Class 3 fit, for the maximum of frictional holding-power in the tapped hole. *Who would knowingly pass up* these features in jigs or fixtures?

Order of your local Industrial Distributor.

The Allen Mfg. Company ★ ALLEN ★ Hartford 1, Conn., U.S.A.

Talide
(TUNGSTEN CARBIDE)
Performance!

TALIDE METAL MEETS EVERY REQUIREMENT

A FEW MAJOR USES FOR TALIDE METAL

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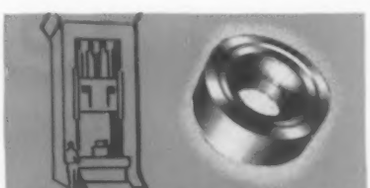
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Drill Jig Bushings

the hardest metal made!

Plug and Ring Gages

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Hardest man-made metal.
Highest modulus of elasticity. (double that of steel)
Extreme Density.
Low coefficient of expansion and contraction.
High compressive strength.
High red hardness.

On any cutting, drawing, or wear resistance application, you can increase production many times and cut costs as much as half. Cutting tools of Talide cut 2 to 3 times faster than high speed tool steel. Talide drawing dies and wear resistance parts usually outwear steel by at least 50 to 1.

Send us parts or prints and we will show you how this hardest man-made metal can improve your production. If you prefer, a Talide sales engineer will call at your office.

THE ENGINEERED CARBIDE FOR ALL APPLICATIONS

TALIDE

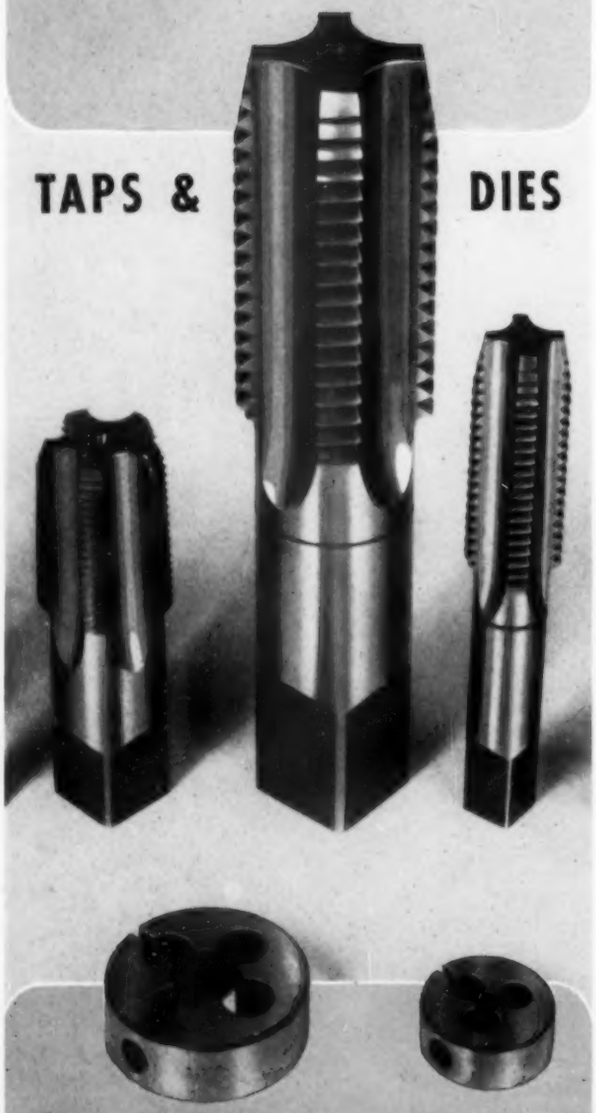
METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*

SINTERED CARBIDES FOR CUTTING • HOT PRESSED CARBIDES FOR DRAWING AND WEAR RESISTANCE

BAY STATE

TAPS & DIES



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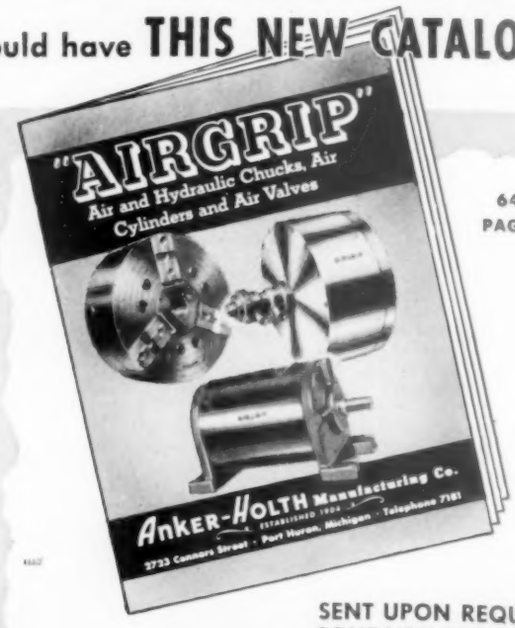
BAY STATE TAP AND DIE CO.

MANSFIELD, MASS.

EVERY TOOL ENGINEER

Should have THIS NEW CATALOG



64 PAGES

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ANKER-HOLTH MFG. CO.

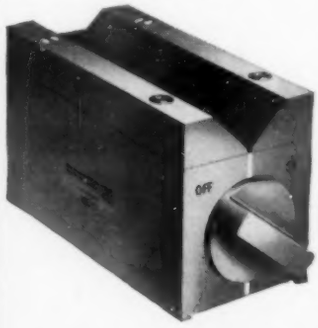
2733 CONNORS STREET PORT HURON, MICHIGAN

No. 750D

MAGNETIC V BLOCK

permanent magnet type

For holding iron or steel work of round or rectangular cross-section or of irregular shape, the Brown & Sharpe Magnetic V Block No. 750D saves precious time on hundreds of toolmaking, inspection and hand operations . . . also on light machine work and wet or dry grinding. For sale only in the United States of America and its territories. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.



We urge buying through the Distributor

BROWN & SHARPE

PERMANENT MAGNET

CHUCKS

SPIRAL OF CONFIDENCE

This is a Midvale High Speed Tool Bit at work. It performs as expected. Every Midvale High Speed Tool Bit is produced under the most carefully controlled conditions. Meticulous attention to all details of analysis, size, heat treatment and finish assures uniformly outstanding performance in your shop. Grades regularly carried in stock include Midvale Two Star, Three Star and V Star. Both sand blasted and finished ground bits are carried in all grades. Confidence in Midvale High Speed Tool Bits increases with use.

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STAINLESS AND TOOL STEEL BARS

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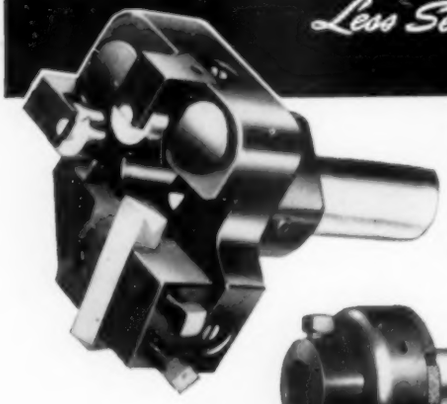
FORGINGS AND RINGS

MIDVALE

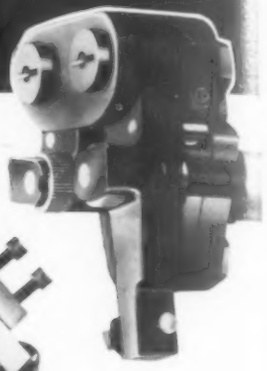
Custom Steel Makers to Industry

BOYAR-SCHULTZ *Full Time* SCREW MACHINE TOOLS

Less Set-up Time Less Down Time
More Production



Much of the costly delay in setting up screw machine jobs can be avoided with Boyar-Schultz Screw Machine Tools. Designed with a full understanding of the problems confronting screw machine operators.



MODEL T Turning Tool.

A new, improved Screw Machine Tool designed with special emphasis on quick accurate set up for precision turning. Less down time is the result of speed in adjustment. Model T Screw Machine Tool is made in five sizes—Nos. 000, 00, 0, 2 and 3.

MODEL D
Floating Tool Holder.

For reaming, counterboring and drilling to close tolerances. In 8 Sizes. No. 000—to No. 6.

MODEL H
Precision Adapter.

A permanent Tool that permits the use of more than one size screw machine tool on a given size screw machine. Made in 6 Sizes.

MODEL G
Universal Tool Bit Grinding Fixture.

Tool Bits can be accurately and uniformly ground with any desired chip clearance angles. Uniformly ground tool bits save time in set-up, save tool steel and save time in grinding.

MODEL K
Knurling Tool.

A new Screw Machine Tool of outstanding design and construction making it possible to perform many of the knurling jobs formerly considered impossible with tools of other types. Speedy in operation, giving clean, accurate knurling in a minimum of time.

Write for complete details on above tools

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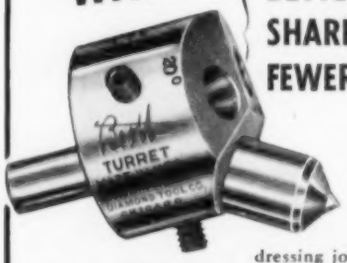


THE **NEW** *Booth*
3-ANGLE TURRET DIAMOND HOLDER

Put the new Booth 3-Angle Turret Diamond Holder on that "finish" dressing job and see how it improves the cut of your wheel. See the automatic, self-leveling action maintain the diamond point at a fixed level with 30°, 20° and 10° drag angles. 3 drag angles give 3 cutting points—double diamond life—reduce re-sets. 3 Angles assure a sharp, clean-cutting diamond—make dressings accurate, improve grinding—save diamonds, save wheels, increase production.

Available on a rental basis of $2.00 per month, payable six months in advance. Rental includes Turret, Block, Adapter Rod, maintenance, repairs, and engineering installation service. Satisfaction guaranteed. (Give make, type and size of grinder when ordering). Specify Booth Turret equipment on your new grinders.

Turret Holder with Adapter Rod

Loc-Key-Set Diamonds (Common 12.00 Carat, Medium 24.00 Carat, Select 48.00 Carat) mounted to fit Turret. Specify Carat size and Quality in ordering.

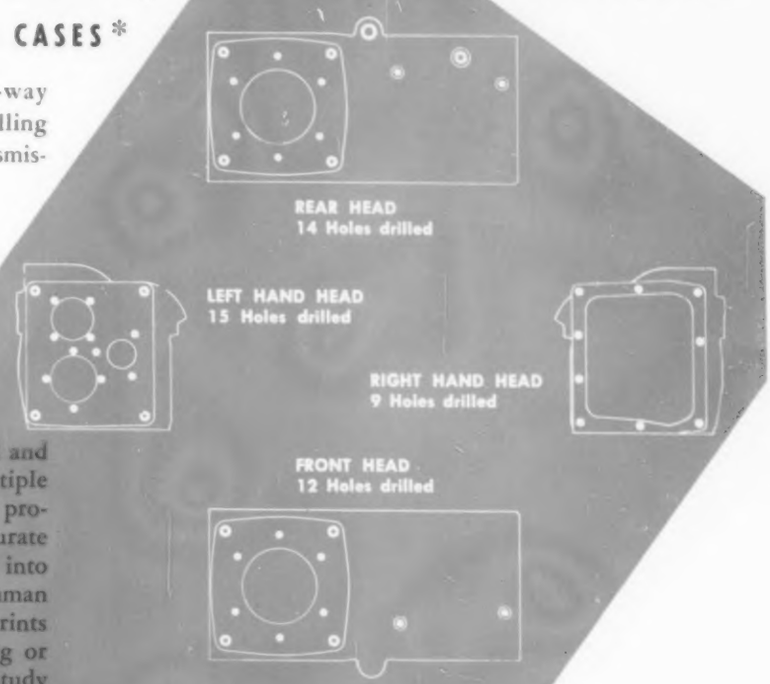
Turret mounted on Block for Surface Grinders

Diamond Tool Co.
(Not Inc.)
Sheldon M. Booth, President
938 E. 41st St. Chicago 15, Ill.
Customers' Overnight Quarters

2600 HOLES DRILLED *Per Hour*

IN TRACTOR TRANSMISSION CASES*

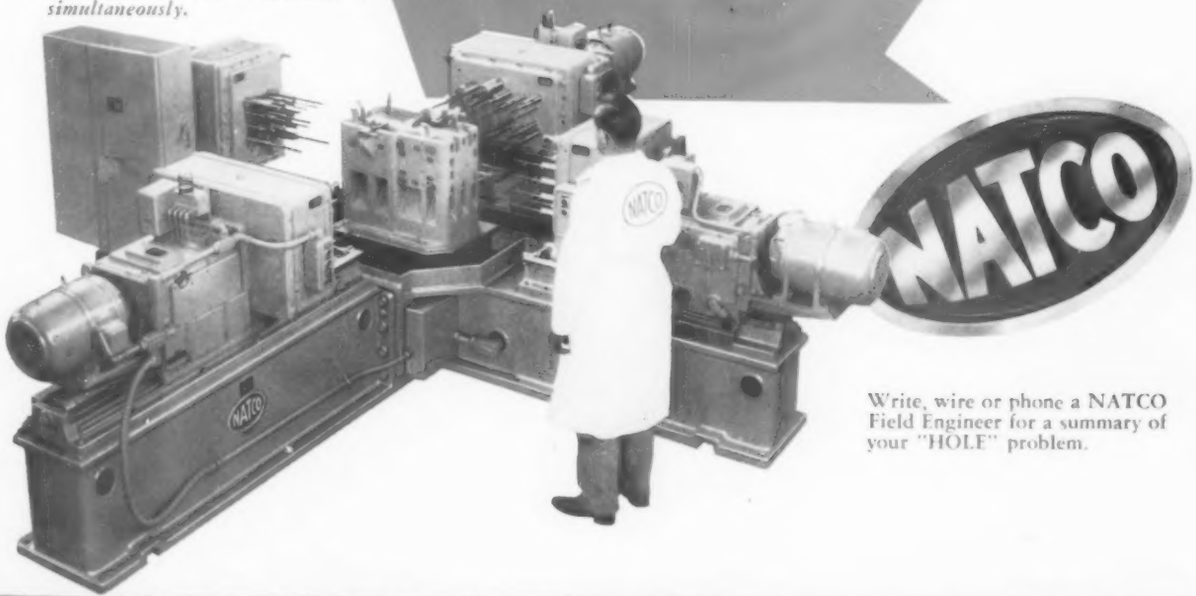
The machine pictured here is a four-way NATCO HOLEUNIT machine for drilling fifty holes in four faces of tractor transmission case at the rate of 52 transmission cases per hour . . . A TOTAL OF 2600 HOLES DRILLED EVERY HOUR. The diagram above shows the holes drilled in the four faces.



Hole sizes vary from 1/4" to 15/16"

These NATCO machines are engineered and built for specific jobs of processing multiple holes automatically, thereby increasing production and reducing hole costs. Accurate work is assured because the skill is built into the machine and the opportunity for human error is held to a minimum. Submit blue prints or specifications of your drilling, boring or tapping work . . . our engineers will study your problem and submit their recommendation without obligation to you.

**Four sides of each transmission case drilled simultaneously.*



Write, wire or phone a NATCO Field Engineer for a summary of your "HOLE" problem.

NATIONAL AUTOMATIC TOOL COMPANY, INC.

RICHMOND, INDIANA, U.S.A.

MULTIPLE DRILLING, BORING AND TAPPING MACHINES

SALES OFFICES: 1809 ENGINEERING BUILDING, CHICAGO; 409 NEW CENTER BUILDING, DETROIT; 1807 ELMWOOD AVENUE, BUFFALO; 2902 COMMERCE BUILDING, NEW YORK CITY

TAPPING TIPS

From Woody Spencer's Notebook

THE RAKE MAKES A LOT OF DIFFERENCE

The yard needed rakin' up the other Saturday afternoon and I couldn't find the leaf rake so I tried the old garden rake. You know what happened. Had to dig the leaves out of the rake every sweep. It got me to thinkin' about specialized tools and (of course) taps in particular. Seemed to me usin' a garden rake was a good deal like tryin' to tap brass or cast iron with a tap ground for steel. It's hard goin'. Takes twice the work. Cuts, tears and spoils the thread, too. The only way to get a tapping job done is to use a tap made for the job. Ordinarily, taps designed for steel are not marked. But when the boys ask us, we're glad to mark the taps designed for other materials. No extra charge either.

Woody Spencer's Tapping Tips aren't published to supply technical information on tapping problems. They merely aim to help with hints, suggestions or short cuts that someone has found handy in making routine tapping jobs go a little smoother or quicker.

For technical information and suggestions on specific problems, send us complete details of the job . . . material, diameter, depth, whether the hole is through or blind, lubricant etc. Our engineers will be glad to give you definite suggestions covering your problem.

NOTE: Woody Spencer's Tapping Tips will appear here as often as Woody gets time to write them up. Look for them.

Woody Spencer's Handy Tap Guide is packed with useful information on tapping. It's free. Write for your copy on the Company letterhead.

THE RIGHT TAP AT THE RIGHT TIME

The Wood & Spencer Company

Cleveland 3, Ohio

DRILL JIG

BUSHINGS

All A.S.A. STANDARD types and sizes in stock for immediate delivery.

Excellent delivery on NEW GAGES and GAGES salvaged by HARD CHROMIUM PLATING.

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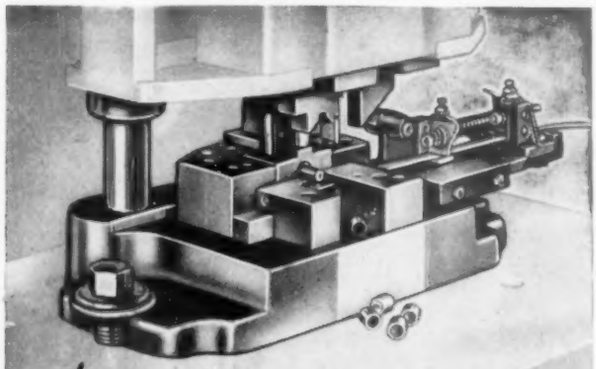

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PEACETIME PROFITS

With Dickerman Hitch Feeds for your punch presses, you'll get top production at rock-bottom cost. They are accurate, reliable and easily changed from one die to another. Send now for descriptive booklet.

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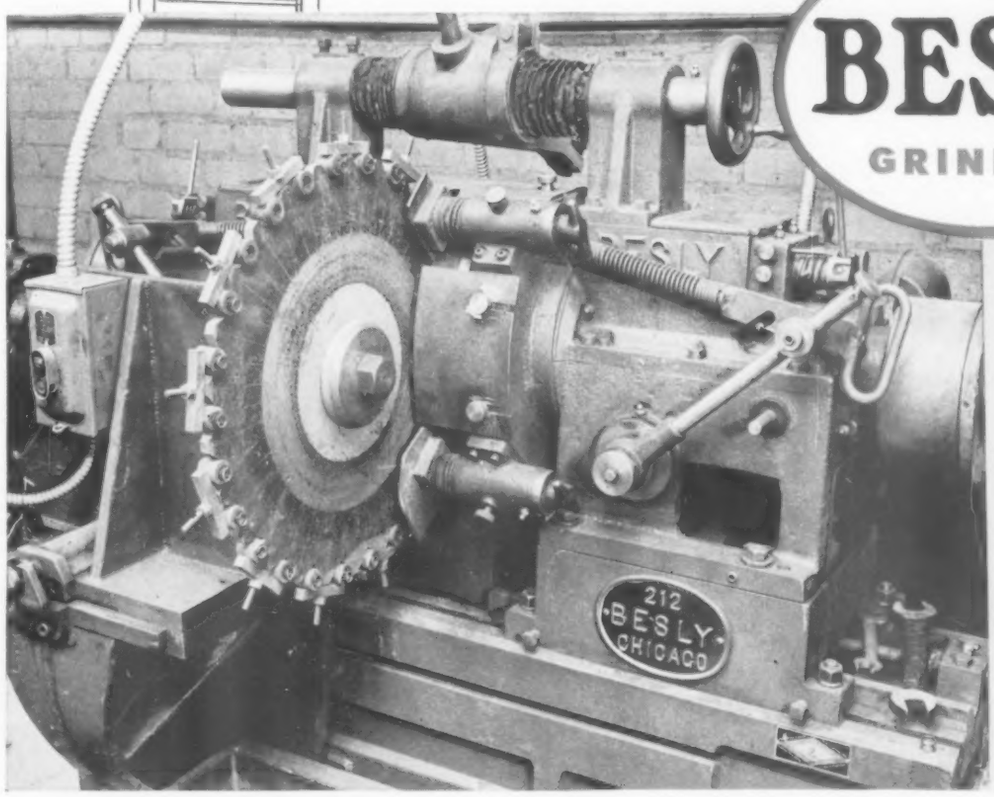
H. E. DICKERMAN MFG. CO.

321E Albany St., Springfield 9, Mass.

RECORD-SETTERS

in high-quality low-cost production grinding



BESLY GRINDERS

No. 212-15 Besly Grinder, equipped with Besly Titan Steelbacs, grinding 18-8 stainless steel regulator springs made of .050 wire.

Top output on an ever-widening variety of production grinding is readily attained with Besly grinders. Typical, is the grinding of many types of springs in the modern plant of the Seaboard Coil Spring Co., Los Angeles, Cal. Here, No. 212 and 218 Besly units provide essential accuracy at a production speed that consistently holds costs within allowable limits.

Other applications of Besly equipment are practically unlimited. With accumulated "know-how" of more than fifty years, Besly engineers are ready to help you develop the right grinder and abrasive—for fast, accurate, economical production.

Write for this Free Booklet
Ask for it today on your business letterhead. It's a valuable reference on grinding wheels and abrasives. Besly Titan Steelbacs are easy to use . . . *they step up production.*

BESLY

BESLY GRINDERS AND ACCESSORIES
BESLY TAPS • BESLY TITAN ABRASIVE WHEELS

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PIONEERing Better Production Methods and Tools

● Maybe you're starting from "scratch" with a completely new product; or possibly you would like to dress up an old one; or this may be the time to get rid of that "bug" which always defied you—regardless of your motive, you'll find here at Pioneer a completely competent staff to help you.

And in the same organization are the brains needed to lay out your plant, design the tools and machinery, set up production and cost controls—everything from design to finished product. These services can be purchased as a complete package or you may have any part of it.

WRITE FOR THIS BROCHURE

"The Answers To Industry's Problems" is a new story of Pioneer's complete service to industry. It tells how Pioneer can help you with product design, quality control, time and motion study, production flow, production control, cost control, and production methods problems. Write for your copy of this interesting and informative booklet.

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A PRODUCTION tool, smooth in operation, engineered to fill a broad field where a fast bench unit can be used most advantageously. It saves time by taking the part to be machined to the grinder instead of taking the grinder to the part as in the case of a portable tool. It leaves the operator with both hands free with which to handle the work; the result, much more production. 3 stages of power.

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Ample Speed . . . Powerful, Smooth in Operation

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Let us help you reduce your cutting tool costs just as we have for hundreds of others

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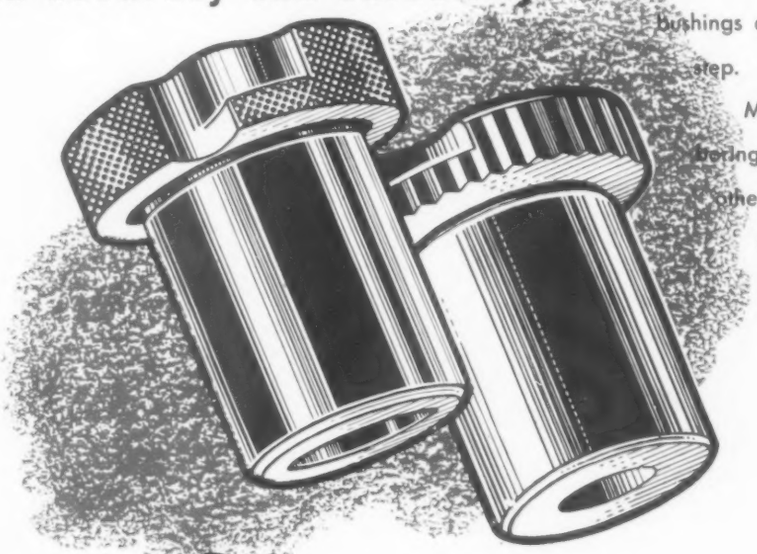
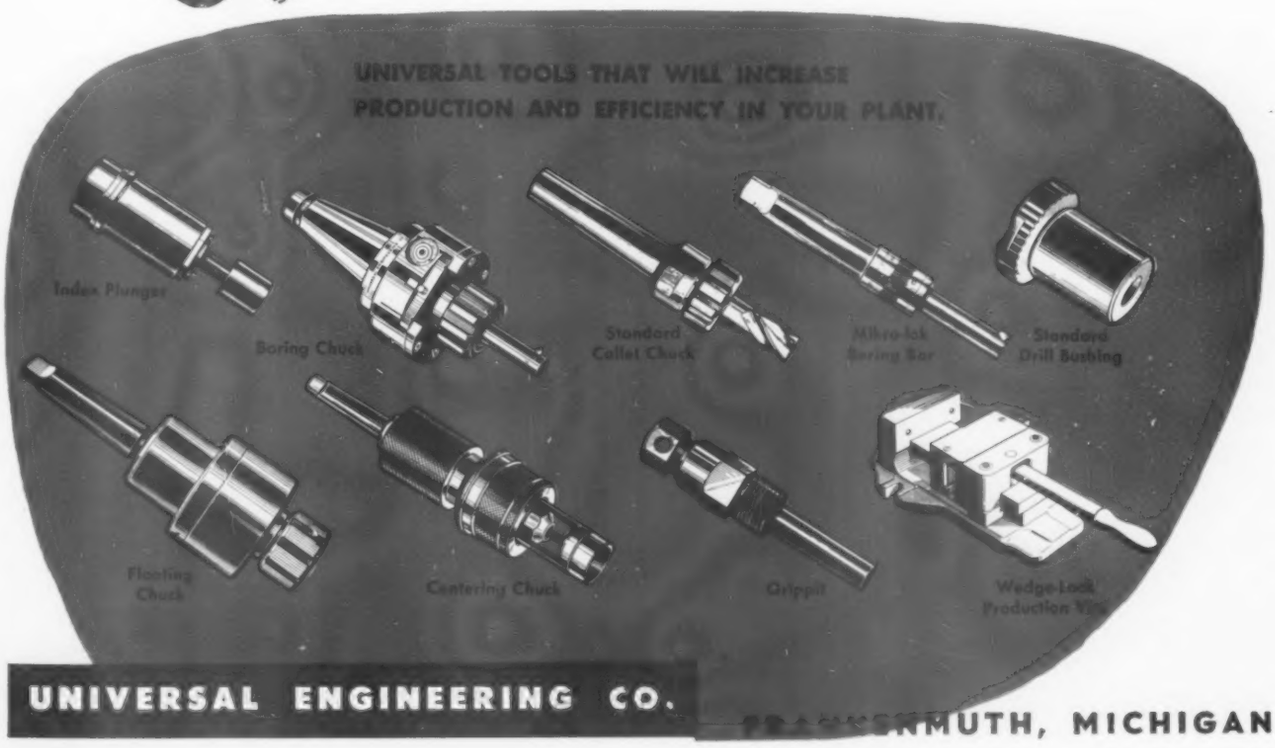
Back in 1919 the founders of the Universal Engineering Co. originated the idea of standard drill bushings. Today, 27 years later, these bushings are saving countless manufacturers thousands of dollars by reducing drill breakage and insuring more accurate drilling, reaming and tapping.

From the selection of the raw steel stock to the finishing of each superhoned bore, Universal superfinished drill bushings are precision manufactured through every step. You can order Universal drill bushings, Mikro-lok boring bars, standard collet chucks, boring chucks, Wedge-lock production vises, and other superior Universal tools direct from the main plant or from the completely equipped Universal Engineering Sales Co. warehouse nearest you: 89 Main St., Ansonia, Conn., or 5629 Sixth St., Kenosha, Wisc.



We will be glad to send literature describing Universal tools upon request



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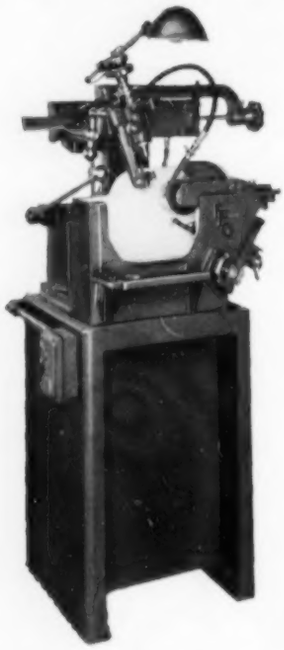

Sharpen SPIRAL POINT TAPS Accurately AND Quickly WITH The NEW

BLAKE FLUTE GRINDER

No longer do you have to scrap spiral point taps for want of an accurate and speedy method of renewing their dull cutting edges. The Blake Flute Grinder—the *only complete* spiral point tap grinder on the market—provides the positive, mechanical controls which reduce the entire sharpening operation to a very few simple, safe, and quickly performed movements.

Spiral point taps—kept sharp on the Blake Flute Grinder—can be ground down to the last two or three threads and *still cut to size.* You'll increase tap life ten times and more . . . cut tens of thousands *more* threaded holes per tap . . . greatly decrease your tap costs and spoilage due to imperfect threads.

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It illustrates many stampings or parts made without dies, gives full details on DI-ACRO machines and shows how they may readily be adapted for various applications. Request your copy now.

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DRILLS ALL THE HOLES AT ONE PASS

Zagar Gearless Drillheads solve your multiple drilling problems. Created and developed by Zagar tool engineers. These drillheads enable your plant to produce a better, more uniform product with astounding savings in time and cost.

Any number of drills, in any pattern, located as close as twice the diameter of the drill, run at full power... noiselessly and vibration-free...on precision needle, tapered roller and ball bearings.

Standardized Zagar Gearless Drillheads are easily adaptable to your drill presses or can be obtained from us as a complete hydraulic machine.

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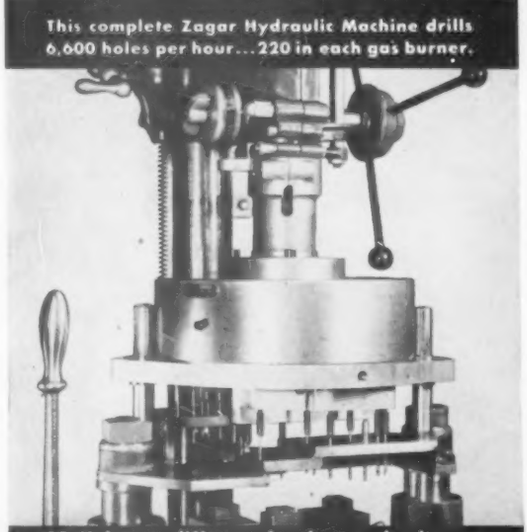
ZAGAR TOOL, INC. • 23880 LAKELAND BLVD. • CLEVELAND 17, OHIO

This complete Zagar Hydraulic Machine drills 6,600 holes per hour... 220 in each gas burner.



18 Holes at different levels are simultaneously drilled by this standard Zagar Drillhead adapted to a 17" Delta drill press.

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Manufacturers of Power Presses to 500 Tons • Rolling Mills • Swagers • Turks Heads.

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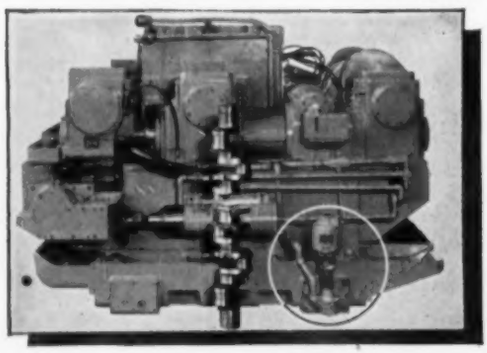

WITH

Photo courtesy The Crankshaft Machine Co.

RUTHMAN GUSHER COOLANT PUMPS

Write for Catalog 101

Model TL7320

To speed production on metal cutting operations turn to Gusher Coolant Pumps.
Illustrated is a "MELLING" TYPE CRANKSHAFT CONTOUR TURNING LATHE, made by the Crankshaft Machine Company and equipped with a ¼ H.P. MODEL SLO-7230 RUTHMAN GUSHER COOLANT PUMP.
Satisfied customers are your guarantee of the service a "GUSHER" will give you. Always specify them on your machines.

THE RUTHMAN MACHINERY CO.

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Proof of LOWER PRODUCTION COSTS with REED Triple-Die *Precision Thread Rolling!*

500 THREADS an hour

Part: Body — Hollow with Thin Wall
Thread: 2"-12NS
Material: Brass

Rolled on the **REED Cylindrical-Die THREAD ROLLER** Model A22

For complete specifications, write for Bulletin A22-1.

ROLLED THREAD DIE COMPANY
Thread Rolling Dies and Machines
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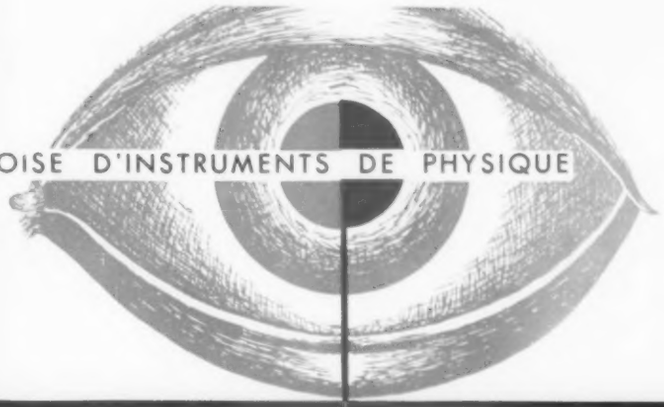
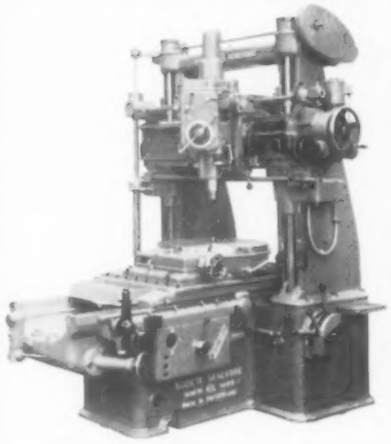
HYDROPTIC-B

SIP SOCIÉTÉ GENEVOISE D'INSTRUMENTS DE PHYSIQUE





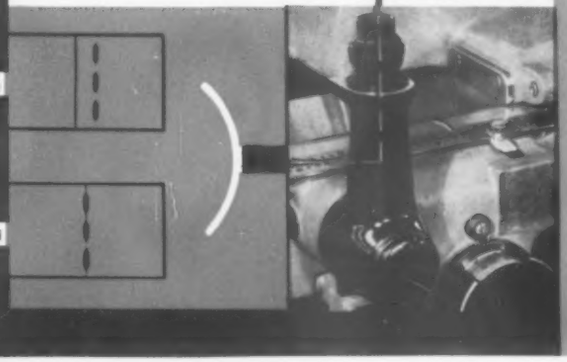
JIG BORING AND MILLING MACHINE

On the SIP HYDROPTIC-B work can be *located, drilled, bored* or *milled* without preliminary laying out and AN ACCURACY FOR ALL SETTINGS OF WORK TABLE AND SPINDLE HEAD OF 0.0002" IS GUARANTEED. The HYDROPTIC-B is more than a jig boring and milling machine since it is also a measuring instrument of unquestioned accuracy.

The measuring system built into this machine represents the ideal setting method since it is actually free from wear and mechanical stress and therefore of absolute permanent accuracy.

SIP Jig Borers are available in the following models:

RANGE OF TABLE SIZES	
No. 2C	18 " x 10¾"
No. 3K	21½" x 15 "
No. 4G	27½" x 23⅛"
HYDROPTIC-B (illus.)	39½" x 32 "
No. 5G	43⅜" x 32 "



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they're dependable

Index High Speed Vertical Milling Machine uses Curtis Universal Joints.

That's what users of Curtis Universal Joints say.

Yes, you too can rely on Curtis Universal Joints for dependable, smooth, trouble-free operation.

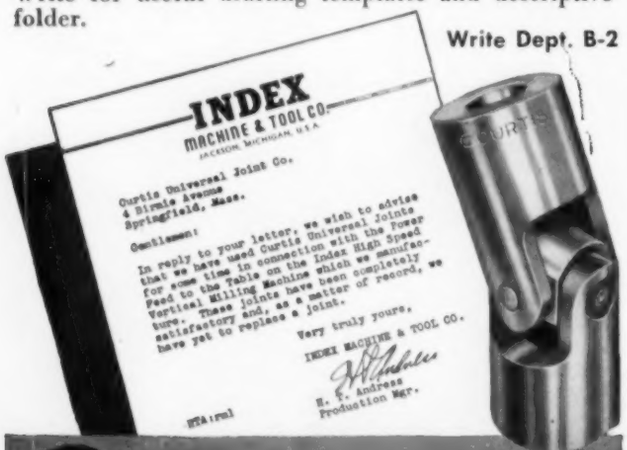
Experience and "know-how" gained in manufacturing universal joints, exclusively, for more than 20 years—with every production operation being done in *One* plant, the largest of its kind—guarantees such dependability.

Curtis is continually making minor changes in design, or materials and heat-treatment that improve Curtis Universal Joint dependability.

For dependable service order from Curtis. War surplus or joints made several years ago do not meet present day quality.

Curtis Engineers are ready to help you at all times. Write for useful drafting templates and descriptive folder.

Write Dept. B-2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JACKSON, MICHIGAN, U.S.A.
Curtis Universal Joint Co.
4 Birnie Avenue
Springfield, Mass.
Gentlemen:
In reply to your letter, we wish to advise that we have used Curtis Universal Joints for some time in connection with the Power Feed to the Table on the Index High Speed Vertical Milling Machine which we manufacture. These joints have been completely satisfactory and, as a matter of record, we have yet to replace a joint.
Very truly yours,
INDEX MACHINE & TOOL CO.
H. S. Andrews
Production Mgr.
HSA:rml
CURTIS

CURTIS UNIVERSAL JOINT CO. INC. SPRINGFIELD MASS.

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TOOLS

(ON THE TIP OF THE TONGUE)

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IN THE ART OF MILLING
WITH CARBIDES

PROMPT DELIVERIES • WRITE FOR CIRCULAR

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Save JOB TIME

IN DRIVING SMALL SCREWS

Specify **ARO** AIR TOOLS

No other tool like it! An *air powered screw driver* for small screws—does a whale of a job speeding up assembly operations!

This sensational new ARO Model 7000 Air Screw Driver is no bigger than the average cigar. Weighs only 8 oz. . . . is 4-⅞″ long and ¾″ in diameter. Capacity No. 1 to No. 6 screws. Starts automatically — no manual throttle. Drives the screw instantly when tool is applied. *Saves time and cuts costs* in production of radios, cameras, electrical appliances, instruments, recording devices, optical frames, typewriters, light fixtures, fishing reels, plastic products, automatic counting devices, speedometers, thermostats, electronic controls, many other products.

For many other jobs of screw-driving, nut-setting, drilling, grinding and similar production work . . . there's an ARO Tool to do it faster and better! Precision-built . . . proven dependability. Write for catalog. The Aro Equipment Corporation, Bryan, Ohio.

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Mac-it ALLOY STEEL SCREWS

Greater strength, more compact design with SOCKET HEAD CAP SCREWS!

Mac-it Socket Head Cap Screws will give you added holding power and permit more compact design where necessary. *All* Mac-it screws are heat-treated and accurately made with die-cut threads. Whatever your needs, let the *complete* Mac-it line serve you. Sold through recognized distributors from coast to coast and in Canada.

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STRONG, CARLISLE & HAMMOND COMPANY
CLEVELAND 13, OHIO
MANUFACTURED BY
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Use this for
GENERAL BORING and for BORING THROUGH HOLES
Boring diameters from 3/32" up
Known as STYLE A

Use this for
BORING BLIND HOLES and BOTTOMING AND FACING
Boring diameters from 3/16" up
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Use this for
INTERNAL THREADING
Thread Diameters from 1/4" up
Known as STYLE C

Because the design of all Bokum Boring and Threading Tools provides a helical relief that assures constant clearance angles throughout entire life of tool—reducing the necessity for resharpening to only one face and thus reducing down time—these tools are regarded as "tops" in all shops where high production is sought. Finish lapped cutting surfaces produce better bores with faster feeds.

Send for folder describing new holder with quick, simple vertical adjustment.

Send for catalog showing all these efficient tools—Ask for N-1139 for super high-speed tools and for N-398 for carbide tipped tools.

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SINGLE POINT BORING TOOLS—INTERNAL THREADING, BOTTOMING AND FACING TOOLS—CARBIDE TIPPED TOOLS

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ACCO

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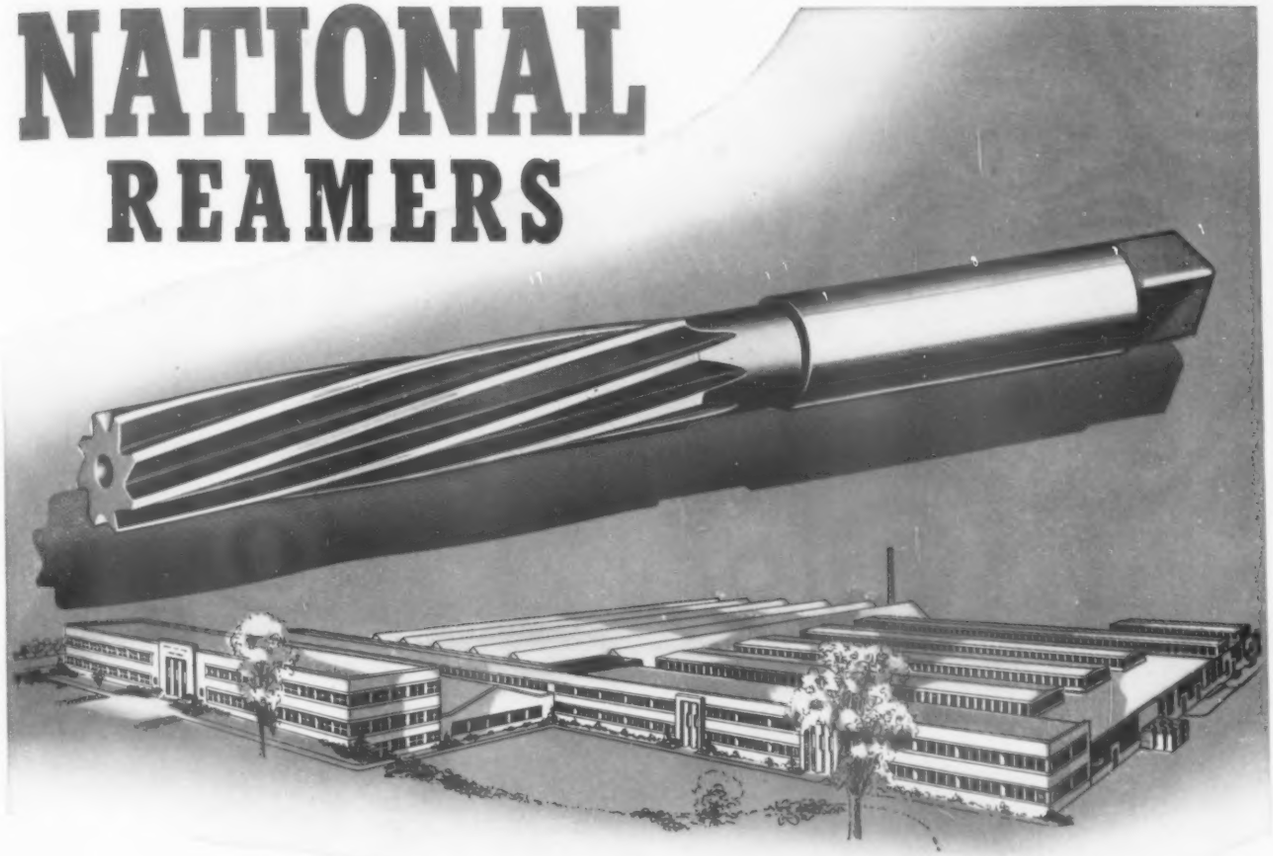
NATIONAL REAMERS



The Importance of Proper Selection

In choosing reamers, such factors as the materials to be reamed, the amount of stock to be removed, and the degree of accuracy and finish required should receive primary consideration. NATIONAL Reamers include such varied types as Taper Reamers, Chucking Reamers, and Shell Reamers, to mention only a few, each designed for a specific use.

Your NATIONAL Distributor can help you select the Reamer best suited to your needs. Consult him on all your metal-cutting problems.

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Leading distributors in every section of the country have stocks of National Cutting Tools. Every National distributor offers factory-trained engineers to serve you. Call your National distributor for cutting tools or any staple industrial product.

NATIONAL

NATIONAL TWIST DRILL & TOOL ROCHESTER MICH. U.S.A.

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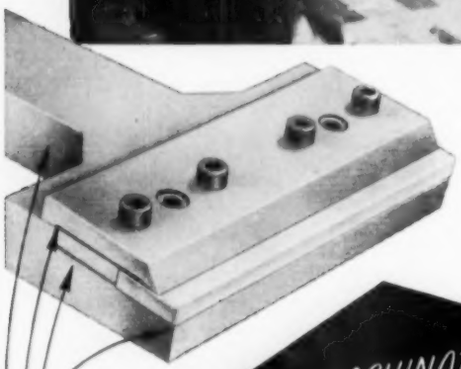
NOW THEY CAN BE TURNED... and at Far Less Cost *



Rugged, solid Kennametal Blade . . . hard, strong Grade K6; clamped-in, advanceable, four cutting edges.

Shank, clamp, and back-up plate are heat-treated steel.

Available in four sizes—cutting widths of blades: 4", 6", 8", and 10".

"UNMACHINABLE" CHILLED CAST-IRON ROLLS [UP TO 90 SCLEROSCOPE] CAN NOW BE TURNED with the NEW KENNAMETAL ROLL-TURNING TOOL

Turning chilled cast-iron rolls costs far less than the traditional process of grinding—and here's the tool that can turn even "unmachinable" castings—up to 90 Scleroscope . . .

A sturdy Kennametal Grade K6 blade is securely held in place on an accurate surface of the supporting shank by a clamp and serrated, advanceable back-up plate—each of hardened steel.

The blade has four cutting edges that may be used in succession before any sharpening is required. Then it can be reground time and again (long sides only) and advanced each time to cutting position, until ⅜ of it has been utilized.

There's one positive way to prove this new Kennametal tool can greatly reduce your cast-iron roll production costs—and that's under actual working conditions in your shop. We'll demonstrate—invite us.

*For example, a roll that required 25 hours for rough grinding was turned with two 8" Kennametal Tools in 8½ hrs.

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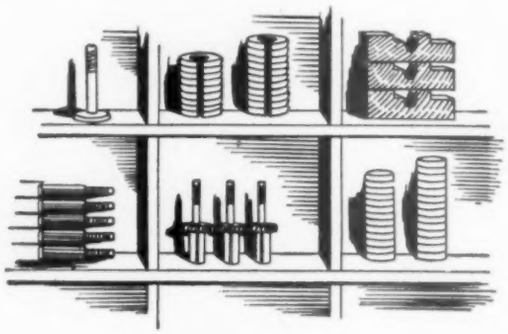

Uniform, legible marking of a product and its component parts speeds up the filling of orders for both the manufacturer and the distributor. It establishes a workable method of stock control and recognition through the use of letter and number symbols. Clear marking eliminates time wasting guesswork and promotes good housekeeping in the stockroom.

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TYPICAL CASE

Part: Journal Boxes (Railroad)
Machine: Bullard 42" Cut Master V. T. L.
Material: Cast Steel (4700 group)
Dia. of bore: 12.405"
Depth of bore: 11"
Depth of cut: 1/8"-7/16"
Feed: .015"
Cut: Intermittent
Pieces between grinds: 14 average (no tool breakage)
Average number of grinds: 30 per tool (tip 1" long)
Best previous carbide: 2 to 3 pieces (frequent tool breakage beyond further use.)

YOU'LL GET

- ★ More pieces between grinds
- ★ More grinds per tool
- ★ Less down time
- ★ Lower tool cost

Prove it

ON YOUR OWN MACHINES

ADVANCED techniques in our metallurgical processing, give the Improved TECO Cemented Carbide such increases in hardness, toughness and uniformity—it is making previous carbide records obsolete.

Plant experience proves that Improved TECO Carbide holds a cutting edge longer and gives far more pieces per tool grind; that its tougher, more uniform structure is much more resistant to wear and breakage. You can operate at higher speeds and feeds, yet tool life is increased.

Prove it yourself! Replace present carbide tools on any machine, with the Improved TECO. Then check your output, grinds per tool, tool life, tool cost. You'll revise your former estimates of top carbide performance.

One of our tool engineers will gladly consult with you or arrange a run at your convenience. If you prefer, send details of your job set up, for proper recommendation. Send for latest catalog and price list.

Improved
TECO
CEMENTED CARBIDE

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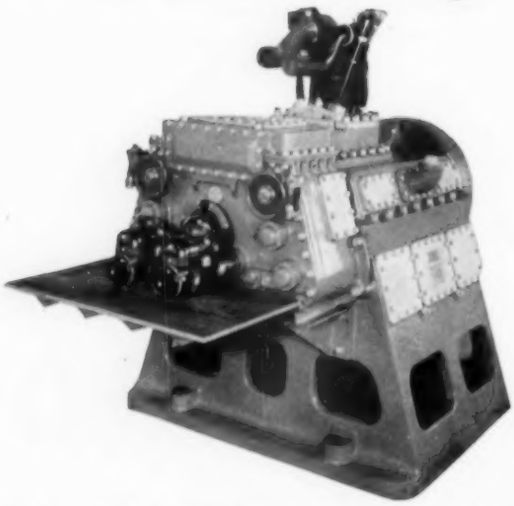
Let Merz Solve Your Unusual Problems of Precision Design



If you're faced with the problem of designing and building an unusual, high-precision experimental engine or test machine, look to MERZ for a sound solution. MERZ is equipped with the best in men, machinery and methods . . . plus the experience of building the most exacting machines for leading research organizations.

Pictured above is a typical example of MERZ work in this specialized field—a single-cylinder, high-precision engine with piston-balanced crankshaft and accessories for testing aircraft cylinder head assemblies—plus testing and developing fuel and ignition systems for high-altitude flying. The extreme accuracy and efficiency in-built in this machine is representative of the workmanship in other MERZ specialties—standard A.G.D. and special gages, tools, dies and other precision products. Write for the full facts on MERZ "four spheres of service" today!

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Exclusive finger-grip brings hand closer for finer work

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$22.50

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-and we can do it!

If you're scheduling volume production involving hydraulic pumps, build your plans around Gerotor. We are prepared to deliver the pumps you need—when you need them! You can depend on Gerotor for timely arrival—for top performance, efficiency and versatility, too. Gerotor has the answer to your hydraulic pump problem—an answer that's ready now! Phone, wire or write.

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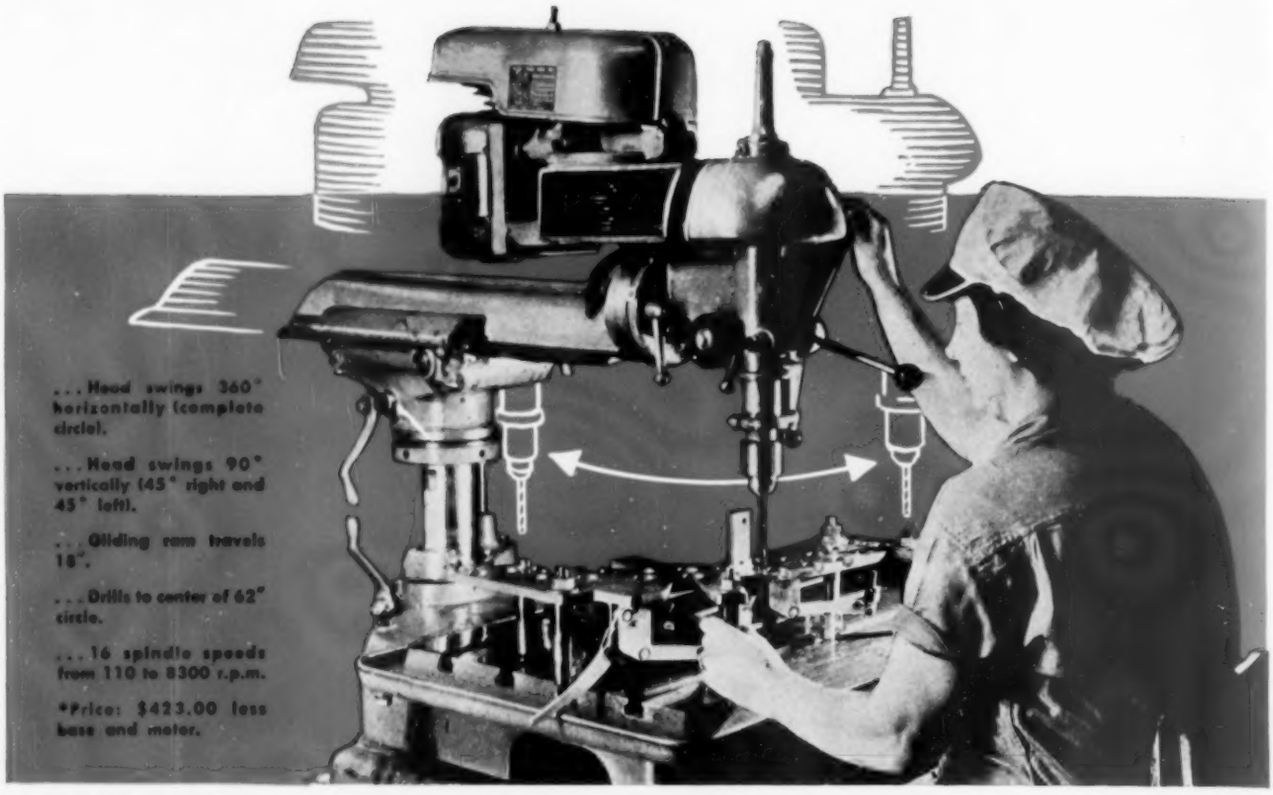
HYDRAULIC PUMPS


. . . Head swings 360° horizontally (complete circle).
. . . Head swings 90° vertically (45° right and 45° left).
. . . Gliding ram travels 18".
. . . Drills to center of 62" circle.
. . . 16 spindle speeds from 110 to 8300 r.p.m.
*Price: $423.00 less base and motor.

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14" METAL CUTTING BAND SAW

Speeds: 61 to 4630 s.f.m.—*Price: $153.00 less base and motor

15" DRILL PRESS—BENCH MODEL

Spindle travel 4¼"—Speeds: 480 to 5000 R.P.M.—*Price: $56.25 less motor and belt guard.

This Radial Drill is typical of a family of Walker-Turner metal working machines that are safe, fast and easy to learn to operate. It's the easiest way to meet everchanging production specifications with lowest overhead and operating costs.

The operator moves the drill to the work—many times on the piece shown. Full vision, easy manipulation—and speed without fatigue —all day long.

A study of the specifications indicates how well it will do your present work and how quickly it can be adapted to a new product or a new material.

Walker-Turner Machines are also the easy way to reduce overhead costs. By increasing production, they write off their low first cost in a few months—wherever metals, wood or plastics are drilled, cut or shaped. The Walker-Turner General Catalog will be sent on request. 22

*F.O.B. Plainfield—slightly higher west of the Rockies and in Canada

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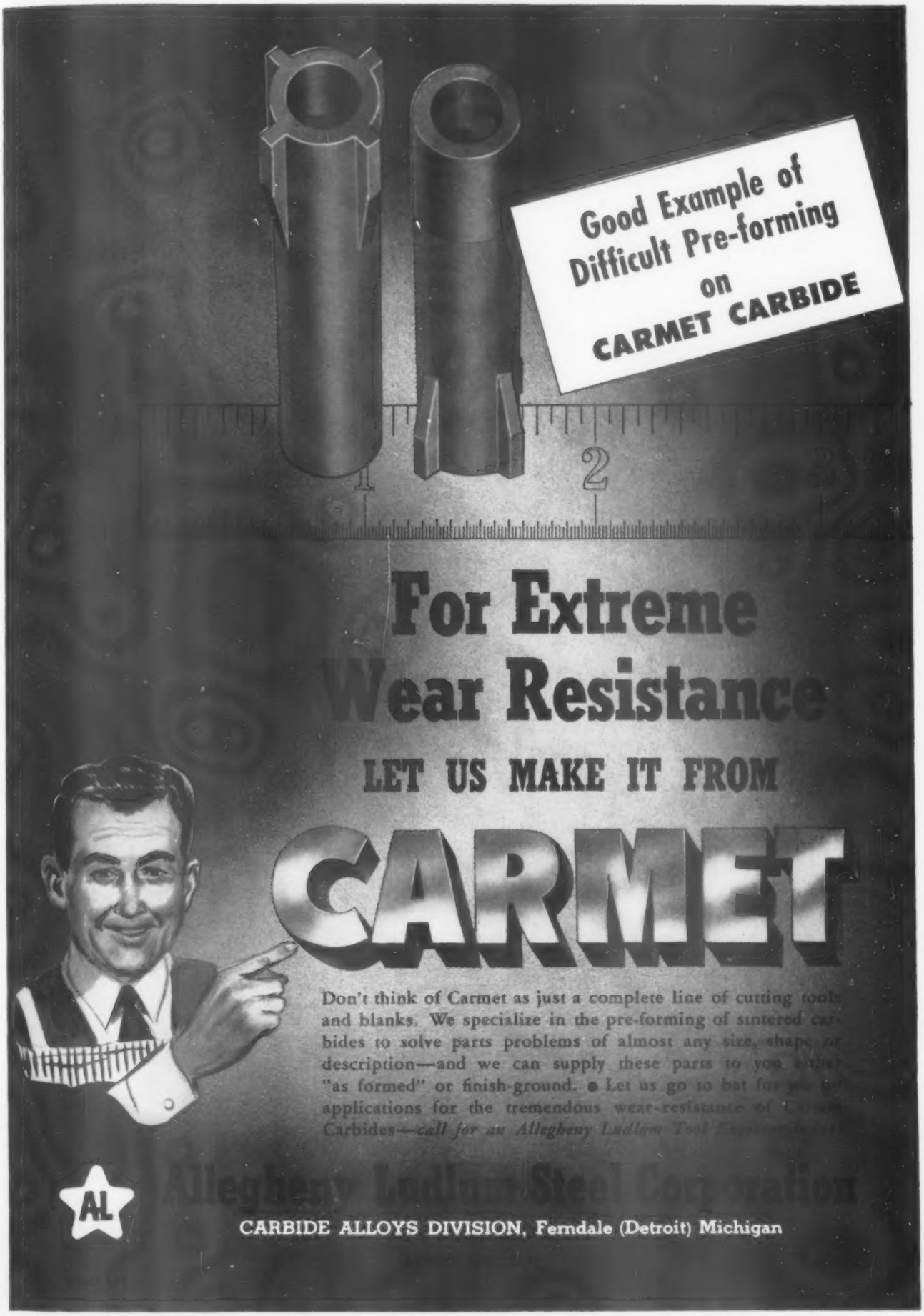
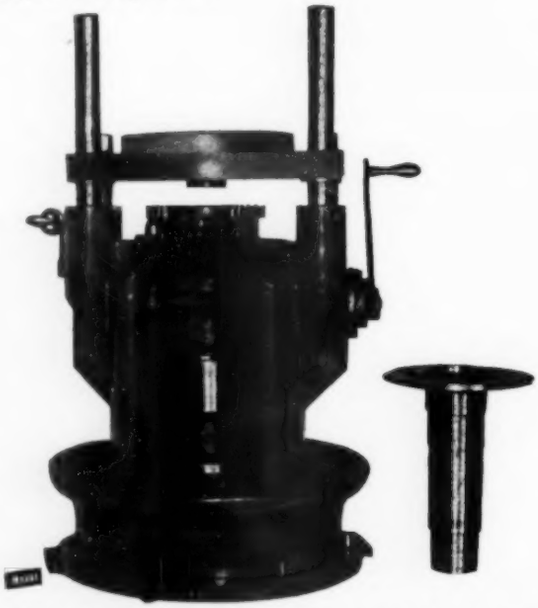
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS


Good Example of
Difficult Pre-forming
on
CARMET CARBIDE
For Extreme
Wear Resistance
LET US MAKE IT FROM
CARMET
Don't think of Carmet as just a complete line of cutting tools and blanks. We specialize in the pre-forming of sintered carbides to solve parts problems of almost any size, shape or description—and we can supply these parts to you either "as formed" or finish-ground. ● Let us go to bat for you on applications for the tremendous wear-resistance of Carmet Carbides—call for an Allegheny Ludlum Tool
Allegheny Ludlum Steel Corporation
AL
CARBIDE ALLOYS DIVISION, Ferndale (Detroit) Michigan

SWARTZ TOOL PRODUCTS CO., INC.

13330 Foley Ave. Detroit 27, Michigan



• DESIGNERS •
• BUILDERS •

EQUIPPED TO HANDLE ANY
OF YOUR TOOLING
REQUIREMENTS
BUILDERS OF STANDARD
FIXTURES AND FIXTURE
LOCKS

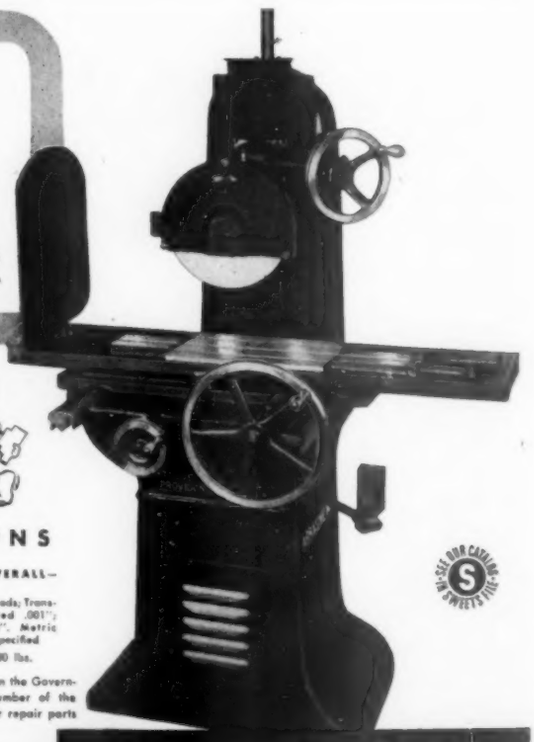
ASK FOR CATALOG 941

A TWO STATION INDEX FIXTURE TO DRILL A CIRCLE OF CLOSELY SPACED HOLES IN SHAFT FLANGE. LOWER ADAPTER CHANGED FOR VARIOUS LENGTH PARTS. TOP PLATE CLAMPS PART WITH STANDARD LOCK.

ABRASIVE

No. 1½

HAND FEED SURFACE GRINDER



The ABRASIVE No. 1½ *completes* the average short-run job before it could even be set up on an automatic machine — and it frees the more expensive machines for production runs. Unsurpassed for grinding dies, flat work and gauges, the No. 1½ grinds jobs up to 10" wide with high accuracy and an excellent finish. Its handwheels are large and conveniently located to make operation easy. There are no sprockets, chains or belting . . . the wheel head with integral motor minimizes vibration and distributes weight evenly on both sides of the guide ways. In every respect this hand feed surface grinder maintains ABRASIVE's high standards of engineering and performance.

WRITE FOR ILLUSTRATED BULLETIN

SPECIFICATIONS

WORK CAPACITY—15" long, 10" wide, 12" high

GRINDING WHEEL—Standard 12" diameter

DRIVE—1 H.P. motor mounted on spindle

TABLE SIZE OVERALL—48" x 11¼"

FEEDS—All hand feeds; Transverse graduated .001"; Vertical .00025". Metric graduations if specified

NET WEIGHT—1330 lbs.

If you desire information on any Abrasive machine on the Government Surplus Tool List just send us the serial number of the machine; we will endeavor to supply attachments or repair parts as ordered.

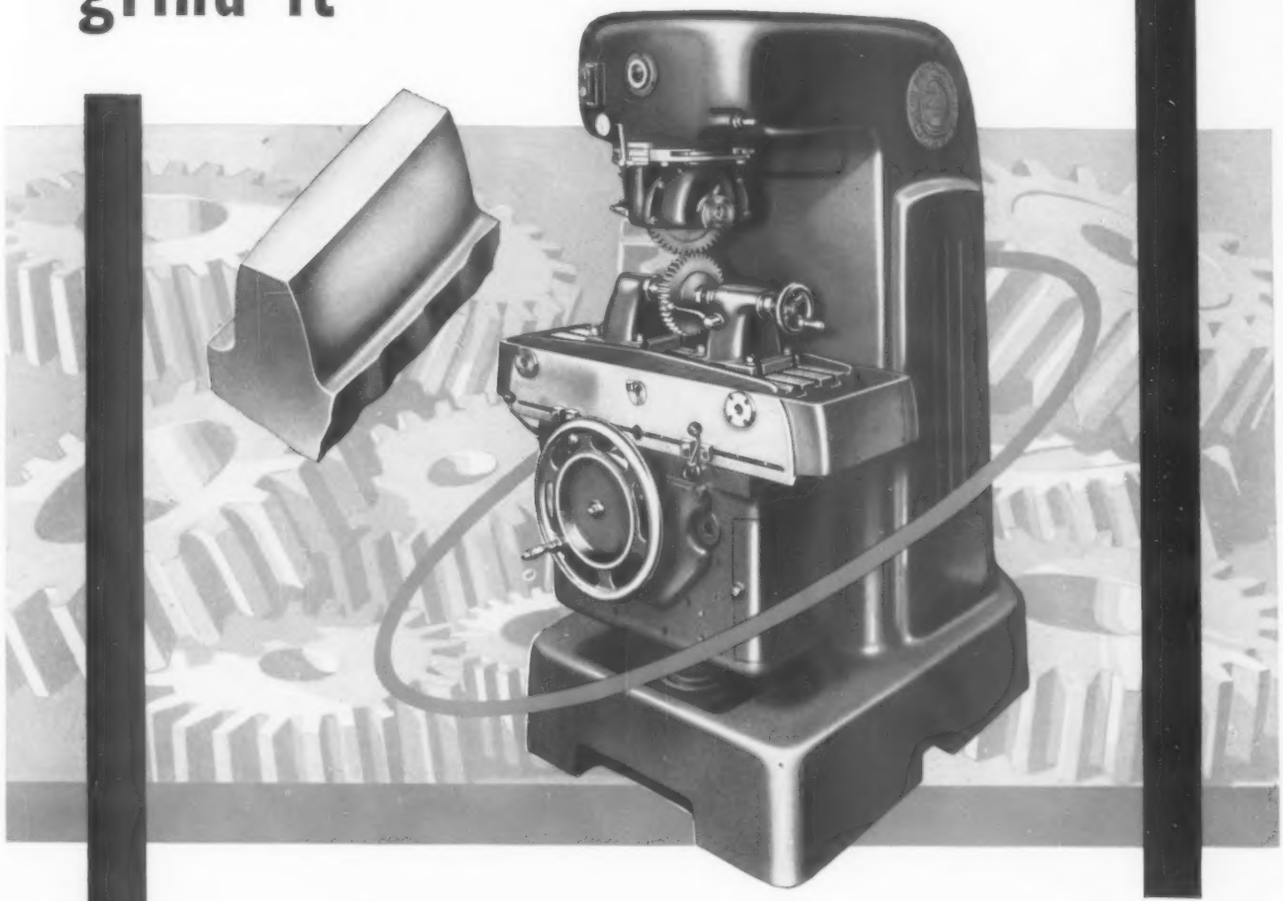
SEE OUR CATALOG IN SWEET'S FILE

ABRASIVE MACHINE TOOL COMPANY

East Providence 14, Rhode Island

ABRASIVE
ACCURACY BOOSTS PRODUCTION

YOU CAN SHAVE A GEAR A LOT FASTER than you can grind it



Gears requiring 40 minutes (floor to floor) for grinding are being shaved in just 5 minutes.

The shaved gears are just as accurate dimensionally as the ground gears; tooth surfaces are just as smooth and of equal if not greater importance, the shaved gear teeth are entirely free of those prevalent hairline grinding cracks which so often result in fatigue failures. Thus by shaving you get better gears faster and at less production cost.

Gears are shaved on Red Ring Rotary Shaving Machines which produce smooth tooth surfaces and correct errors of helical angle, profile and eccentricity. Gears from 3/16" to 220" P. D. can be shaved. Those from 3/8" to 36" P. D. can also be crowned to avoid the danger of failure due to "End Bearing."

NATIONAL BROACH AND MACHINE CO.

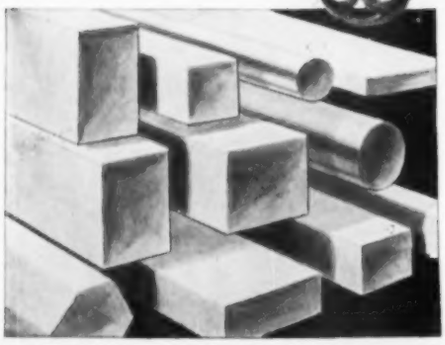
5600 ST. JEAN — RED RING ◯ PRODUCTS — DETROIT 13, MICH.

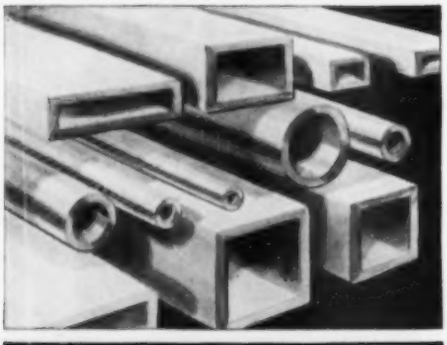
SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

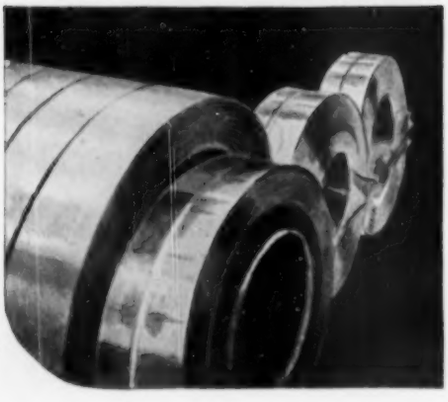
ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

NOW

Brass Mill Products Quickly!







A large supply of brass mill products is now offered to the trade at unusually low prices. The entire inventory may be fabricated by normal production methods and is being sold in production quantities.

The inventory includes: Free Turning Brass Rod—1 inch diameter and larger; Copper and Brass Tubing—3 inch O.D. and larger; Naval Brass Rod—various diameters; Aluminum Bronze, Manganese Bronze and Silicon Bronze in various shapes.

• • •

This material is offered in the following sequence as provided by law: (1) Certified Veterans of World War II; (2) Subsequent priority claimants; (3) Non-priority purchasers. Federal agencies have had opportunity to fulfill their needs. VETERANS OF WORLD WAR II should apply to their nearest WAA Regional Office for certification; the case number assigned and the location of the certifying office must be stated in a Veteran's offer to purchase.

EXPORTERS: The War Assets Administration solicits your inquiries. Communicate with your foreign clients promptly.

WAR ASSETS ADMINISTRATION

Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles

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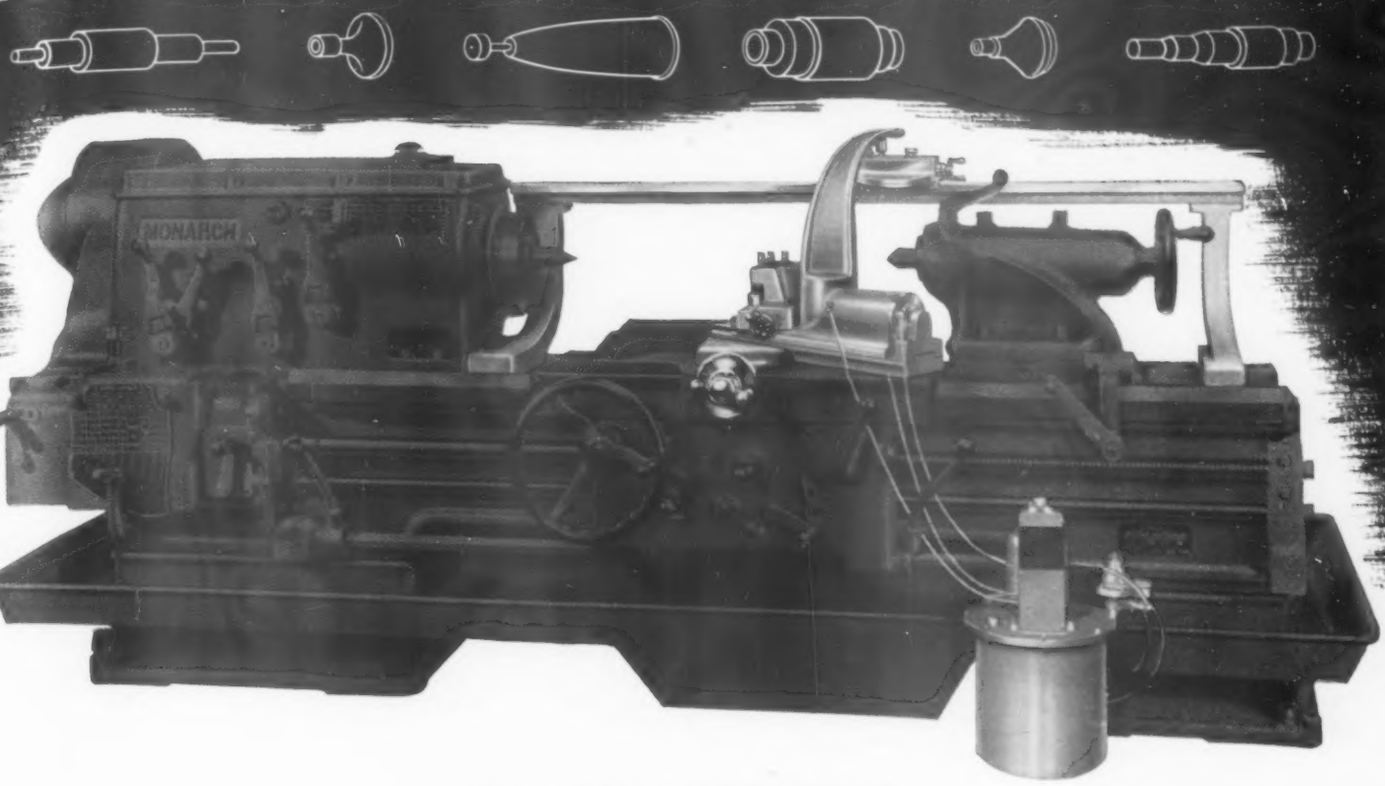
FOR TURNING CONTOURS AND STEP SHAFTS



THE NEW EXCLUSIVE

MONARCH "AIR-TRACER"

FORMERLY KNOWN AS THE BAILEY DUPLICATING ATTACHMENT

Stepless increasing contours—machined to correspond to the template within a limit of tenths—and with a continuous finish that often eliminates subsequent grinding operations!

That's the kind of work you can do—*and faster*—with a new Monarch "AIR-TRACER" equipped lathe. You'll get greater precision—*greater production*—on increasing contours and on step shaft work, too. (Automatic sizing is an important integral feature.)

The "AIR-TRACER" has a proved production record for saving time, money and material on such diversified work as mandrels, punches, dies, nozzles, spinning chucks, impellers, valves, metering pins, molds—*and a wide range of step shafts.*

If you're doing these classes of work, you'll want to know all about the new Monarch "AIR-TRACER", offered exclusively on new Monarch Turning Machines equipped at the factory. You can get complete, detailed information in Bulletin 2601. Ask for your copy.

Check these advantages

- ★ **Stepless cutting-tool motion—*for increasing contours and a superior continuous finish.***
- ★ **Air-gage sensitivity combined with hydraulic power's versatility and ease of control—*an exclusive Monarch feature.***
- ★ **Automatic sizing eliminates repetitive setups and measurements—*for faster production, fewer rejects.***
- ★ **Continuous feed of slide on increasing diameters—*for more uniformly high finishes.***
- ★ **Exact conformance to template contours—*changes in template shape translated instantly into slide movement.***
- ★ **Feed infinitely variable from 0 to 20" per minute—*for maximum machining efficiency on all materials and diameters.***

ACCURACY · ECONOMY · LONG LIFE

THE MONARCH MACHINE TOOL CO.

Sidney, Ohio

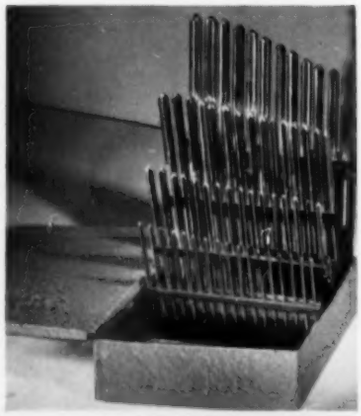
Monarch TURNING MACHINES

WHO SAYS I DON'T NEED SPECIALLY MADE ODD SIZE REAMERS?

We do mister! Because L & I Wire Gage Reamers readily fill the gaps between standard fractional sizes. They give you a wide range from which to choose and frequently save you the added cost of having odd sizes specially made. For instance: in the full range of L & I Wire Gage Reamers #1-60 there are 5 graduated sizes between regular 1/16 and 5/64 diameters, any one of which is available in any quantity, direct from stock.

Check this too, mister! L & I Wire Gage Reamers are ground from the solid bar *after the bar is hardened!* Result? Closer dimension control; finer surface finish; keener cutting edges that have longer life and need fewer resharpenings!

LAVALLEE & IDE, INC. • CHICOPEE, MASS.

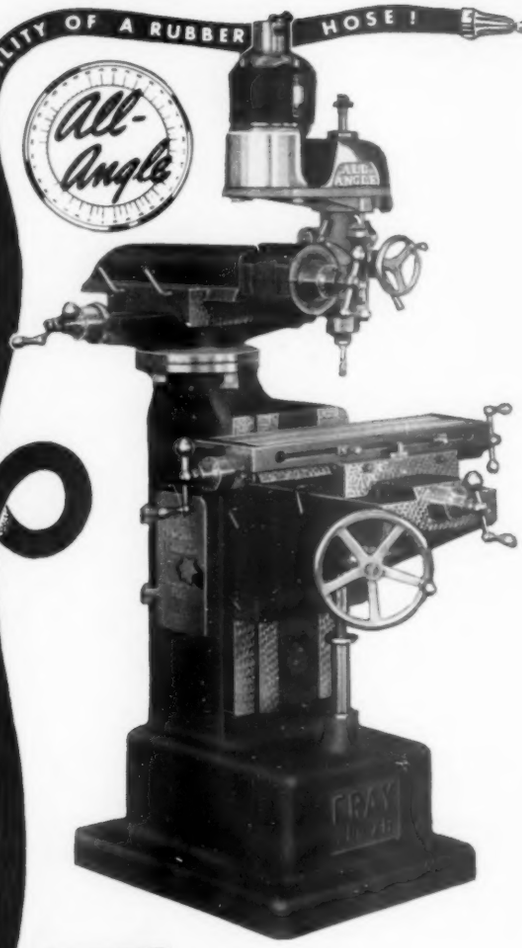


Write today for illustrated Price List 46. It gives the decimal dimensions of these 60 in-between size Wire Gage Reamers made to save you plenty of time, trouble and money.

L&I GROUND FLUTE REAMERS

FLEXIBILITY OF A RUBBER HOSE!

All-Angle



Fray

PRECISION RAM TYPE NO. 7-B

VERTICAL UNIVERSAL

MILLING MACHINE

- Flexible
- Sturdy
- Universal
- Easy to operate
- One set up
- All angles quickly obtained

- Four Sizes
- Four Types
- Adaptable to all Milling Machines

For further information write Dept. H

NATIONAL DISTRIBUTORS

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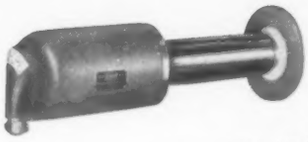
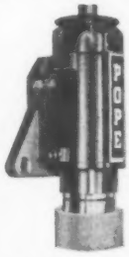
AGENTS IN ALL PRINCIPAL CITIES

These POPE PRECISION SPINDLES are ready to go to work in your grinders



This POPE *Sealed Motorized Spindle* is recommended for all makes of 6" x 18" surface grinders. It has sealed-in 1 H.P. G-E motor and sealed lubrication, SKF super-precision, double row roller bearings. It assures finer finishes and more production per day and per Spindle.

This POPE *Internal Grinding Spindle* with sealed lubrication and speeds up to 35,000 RPM is recommended for the production of more accurate hole sizes and better finishes. It comes in a wide range of sizes and speeds.



This POPE *Motorized Spindle*, with Sealed Lubrication and with 3, 5 or 10 H. P. motor running at 1200, 1800 or 3600 RPM is recommended for a broad range of surface grinder and boring applications. It has the bearing capacity and the rigidity to rough off surplus metal fast and produce a better final finish. It will run in any position.

This POPE *Tool and Cutter Grinder Spindle* with Sealed Lubrication is operated by single Vee belt drive at speeds up to 6000 RPM. It meets POPE standards of precision, efficiency and lasting performance. Fits standard grinders.

This POPE *Double-Ended Tool and Cutter Grinder Spindle* with Sealed Lubrication is designed for twin belt pulley center drive at speeds up to 6000 RPM. Fits standard grinders.

These modern "Package Units" have a sealed-in supply of lubricant good for the life of the bearings. Each is a product of extensive research and long experience in the design and manufacture of Precision Spindles. For prompt action get in touch with Spindle headquarters . . .

No. 38

POPE

POPE MACHINERY CORPORATION

ESTABLISHED 1920

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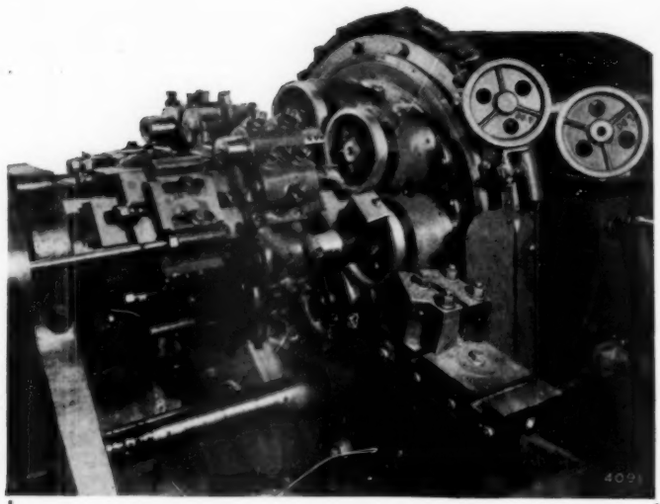
BUILDERS OF PRECISION SPINDLES



GEAR BLANKS ARE TURNED ACCURATELY AND SPEEDILY ON

"BAIRD" AUTOMATIC CHUCKING MACHINES

Here is shown a "Baird" No. 76H Chucking Machine, set up for turning, facing and boring gear Blanks made of a Special Cast Iron having a Rockwell hardness—85—90 B Scale.

The O.D. is finished turned to 6.800 plus or minus .001 and both faces are finished to 1.000 width, plus or minus .001.

The Hole is finished bored and reamed .750 diameter to plug gage and is concentric with the O.D. turning within .001 total indicator reading.

The work is held in Standard "Baird" Three Jaw Contracting Chucks, using stud type jaws for gripping. (The Spindle Turret is shown partially indexed to better illustrate the method of chucking.)

This gear is completely turned as shown to the required accuracy at the rate of 55 pieces per hour.

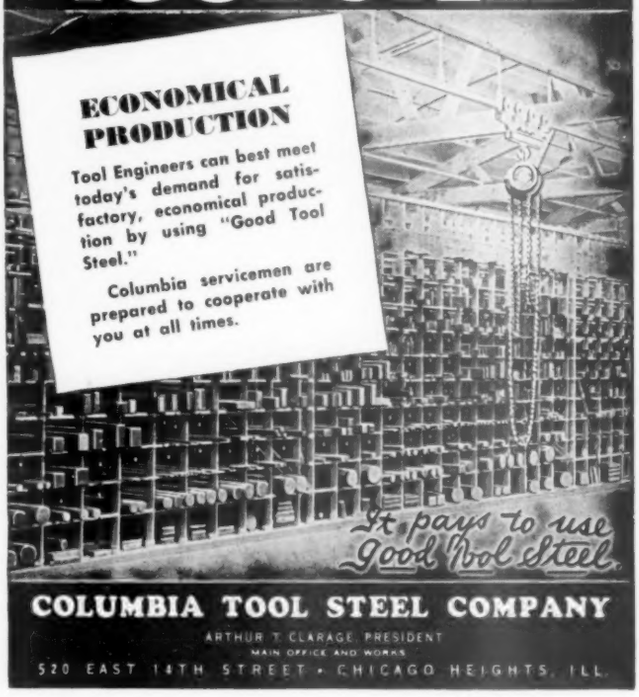
Selection of a spindle speed for each position, which is a special Baird Feature, permits high Spindle speeds in the finishing positions where carbide tools are used to produce the fine accurate surfaces required.

When you have Turning Operations that should be done profitably

"ASK BAIRD ABOUT IT."

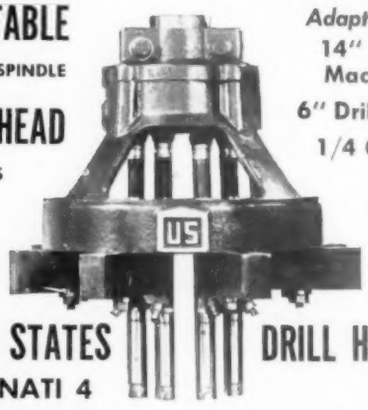
THE BAIRD MACHINE COMPANY
STRATFORD, CONN.

Columbia TOOL STEEL


ECONOMICAL PRODUCTION
Tool Engineers can best meet today's demand for satisfactory, economical production by using "Good Tool Steel."
Columbia servicemen are prepared to cooperate with you at all times.
It pays to use Good Tool Steel

COLUMBIA TOOL STEEL COMPANY
ARTHUR T. CLARAGE, PRESIDENT
MAIN OFFICE AND WORKS
520 EAST 14TH STREET • CHICAGO HEIGHTS, ILL.

ADJUSTABLE
MULTIPLE SPINDLE
DRILL HEAD
8 SPINDLES



Adaptable to
14" & 17" Machines
6" Drilling Area
1/4 Capacity
21/32 Centers

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DIAMONDS FOR WHEEL DRESSING TOOLS
DIAMONDS FOR THREAD GRINDING TOOLS
DIAMONDS FOR ALL INDUSTRIAL PURPOSES

KOEBEL

Koebel Diamond Tool Co., 9456 Grinnell Ave., Detroit 13

VICKERS HYDRAULIC CONTROL means *Greater Productivity and Versatility* FOR ETNA Tube Cutoff Machines

Important advantages of Vickers hydraulic controls that make for higher production rates and greater versatility are illustrated by this Etna Hydraulic Tube Cutoff Machine. Completely automatic is the cycle which feeds the tubing rapidly and accurately to length within a few thousandths, provides quick action clamping, cuts off and then unclamps the stock. Feeding and clamping rates are varied by simply turning a dial . . . there are no cams or gears to change. The rapid traverse approach of tool slides and the rapid return save time. The machine is compact and completely self-contained; it is changed from one diameter of tube to another in a few minutes.

Investigate the resources of Vickers hydraulic controls for your machines . . . talk to a Vickers application engineer.

VICKERS Incorporated
1416 OAKMAN BLVD. • DETROIT 32, MICH.

Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI
CLEVELAND • DETROIT • LOS ANGELES • NEWARK • PHILADELPHIA
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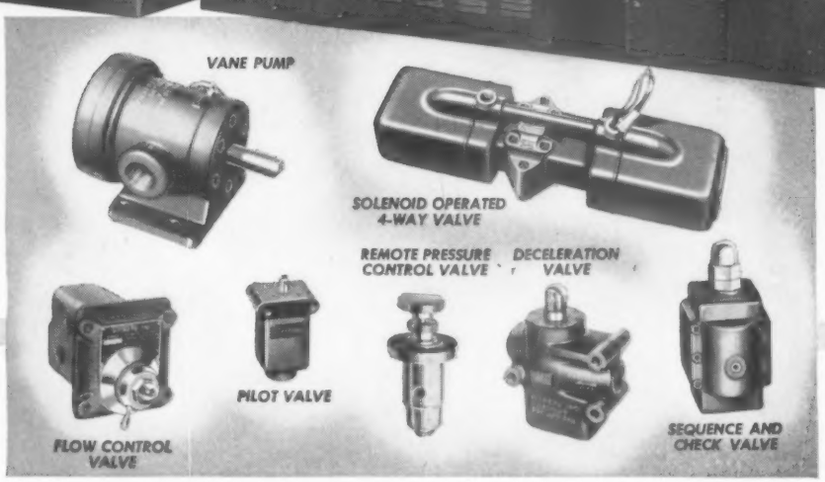
Engineers and Builders of Oil Hydraulic Equipment Since 1921



Representative Vickers Hydraulic Control Units used on Etna Tube Cutoff Machine

Better Grinding

★ Greater Production
★ Finer Finish
★ Longer Wheel Life

...by the barrel

CODOL Liquid Grinding Compound has often proved to be the primary factor in turning an unacceptable performance into a complete success. One user said: "When Codol replaced another fluid for grinding a crankshaft, wheel life jumped from 14 to 20 pieces and gumming disappeared." Says another: "Of seven compounds tested, Codol produced the best finish." And another: "Since standardizing on Codol for surface grinding, wheel and segment life has improved and rusting has been eliminated."

A Stuart Engineer will help you apply Codol to your advantage, whatever your grinding problems may be. Ask him to visit you.

Write for "Up-to-Date Grinding Practice"

D.A. Stuart Oil Co.
EST. 1865 LIMITED

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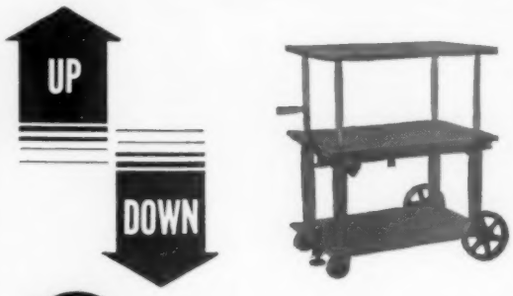
Stuart Oil Engineering Goes With Every Barrel



PORTELVATOR is the handiest necessity in any plant. Moves heavy material without strain. Raises. Lowers. Then moves again to the next operation.

Used to support overhanging work. To lift heavy castings. To load and unload. To transport supplies. Used in a thousand ways to expedite the work and lessen the strain of lifting and holding. Even used as a portable work bench.

Many models in stock. Special models designed and built to fill your particular need.

Write for literature and prices. Now! And be prepared to solve a problem when production pushes for attention. Address Department F.

THE Hamilton TOOL COMPANY

SUPER SENSITIVE DRILLING MACHINES · TAPPING MACHINES · PORTELVATORS

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Easy Way TO OVERCOME SPINDLE MISALIGNMENT!

If you at times have difficulty in getting operators to make spindle alignments absolutely accurate in tapping or reaming, there's an easy way to end your troubles. Supply them with Ziegler Floating Holders.

By automatically compensating for inaccuracies in spindle alignment up to 1/32" radius, or 1/16" diameter, the Ziegler Holder insures perfect work in spite of carelessness on the part of the operator.

This is why the Ziegler Holder is coming into increasingly widespread use. You'll save yourself a lot of grief by changing over to Ziegler Holders for all of your tapping and reaming jobs.

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1930 Twelfth Street Detroit 16, Mich.

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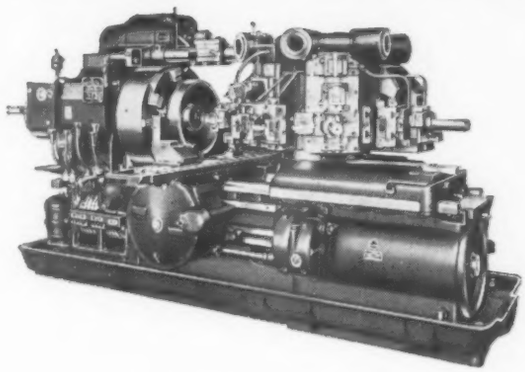
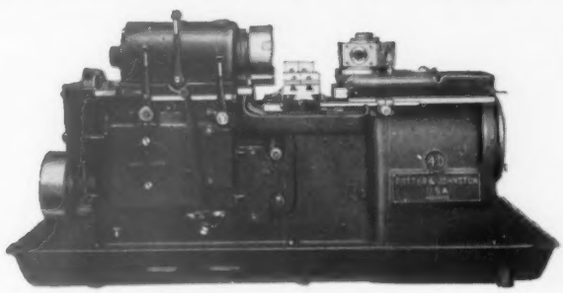
Ziegler ROLLER DRIVE FLOATING HOLDER for Taps and Reamers...

P&J AUTOMATIC CHUCKING and TURNING MACHINES

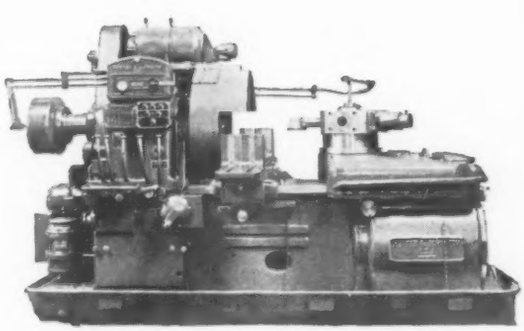
Leaders in their field for more than 40 years



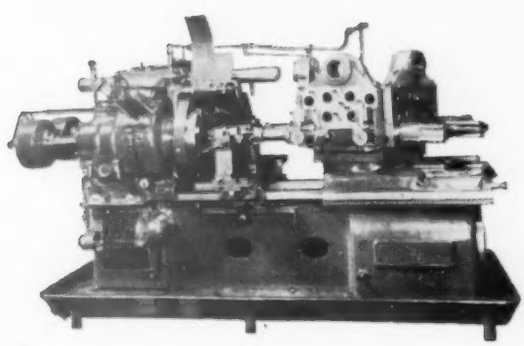
P&J 8DT and 8DXT Automatic



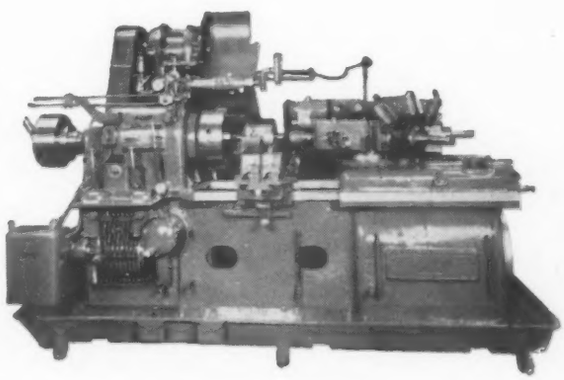
P&J 4D Automatic



P&J 6D REL and 6D REELX Automatic



P&J 5D Two Spindle Power-Flex Automatic



P&J 5D Power-Flex Automatic

BUY THOSE EXTRA VICTORY BONDS NOW!

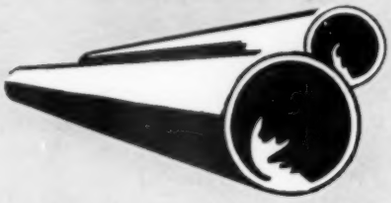
The complete line of P&J Manufacturing Automatic Chucking and Turning Machines covers practically all requirements for size range of work. High accuracy, fast work and convenience in handling are assured whether parts produced are small or large. Every machine regardless of capacity, can be tooled and re-tooled to provide the utmost in flexibility for meeting specific machining requirements.

P&J engineers are available to help you with your production problems. Ask for descriptive literature covering P&J machines.

Authorized Agent, U. S. War Assets Corporation

POTTER & JOHNSTON MACHINE COMPANY

BARGAIN PRICES ON



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Carbon, Alloy and some Stainless. Both Welded and Seamless.

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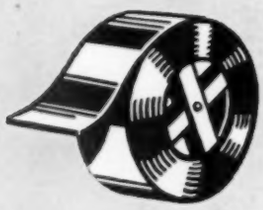
Water-hardening, Oil-hardening and High Speed Grades.



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Hot Rolled, Cold Rolled, Carbon, Alloy, and Stainless.

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Hot Rolled and Cold Finished in Carbon, Alloy, and Stainless.

All steel is subject to priority regulations. VETERANS OF WORLD WAR II are invited to be certified at the War Assets Administration Certifying Office serving their area and then to purchase the material offered herein.

EXPORTERS: The War Assets Administration solicits your inquiries. Communicate with your foreign clients promptly.

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Alloy steel billets, blooms, bars, plates, are all immediately available through your War Assets Administration. Bars include rounds, squares, flats and hexagons. Suitable for substitute and re-rolling purposes.

Low prices on this high grade steel make it practical for low-cost products.

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You can

TAPS *That Thread Well*

by the THREADWELL DOT

Threadwell "*i-dot-ification*"—*red* dot for cut thread, *white* for commercial ground, *blue* for precision ground—is more than a quick, convenient means of identification for use and a positive assurance you get the tap you pay for. It identifies the tap as a product of *Threadwell* precision craftsmanship; a tap that has met the most exacting standards of testing and inspection; a tap that will give you better threads and more threaded holes whether you're tapping steels, cast iron, alloys or plastics.

Threadwell is a good name to remember. Look for the name and the color dot on every high speed tap. *Threadwell* Taps are available through a leading Mill Supply Distributor in your locality. Let us put him in touch with you.

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Threadwell Taps have

COLD-TEMPER—treated at 120° below zero for extra toughness without brittleness.

TAP-CAPSULE—in individual transparent plastic tubes that protect ground-threads and permit quick selection of type and size before unwrapping.

GREASELESS RUST-PROOFING—by an exclusive *Threadwell* process that keeps the tap clean and dry, ready for instant use.

Remember. Threadwell COLD-TEMPER I-DOT-IFIED, TAP-CAPSULED, RUSTLESS Taps *cost no more* than any other high speed taps.

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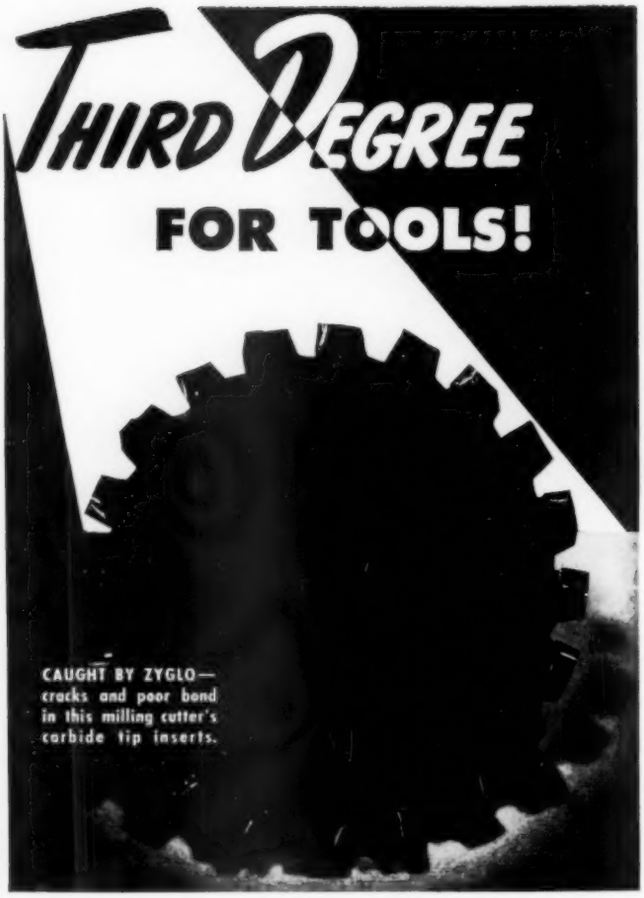

CAUGHT BY ZYGLO—cracks and poor bond in this milling cutter's carbide tip inserts.

Cross-Examined with

ZYGLO*, Tools Tell All *BEFORE* They Break Down

• The time to uncover the guilty secret of an apparently sound tool—is *before* it is shown up by breakdown. There is no escaping exposure for such defects in tools examined with Zyglo . . . under "black" light it brings them out in fluorescent brilliance.

Flaw detection with Zyglo is simple, economical, non-destructive . . . *sure*. Information gained by its use is doubly profitable to both producer and purchaser—to the first, because it eliminates costly work waste and permits consistent quality control—to the latter, because it eliminates acceptance of faulty tools and prevents costly product spoilage by their use.

Write for complete data on Zyglo . . . the practical way to get the whole truth from tools . . . *today*.

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ZYGLO* — Reg. U. S. Pat. Off. Trade Mark of Magnaflux Corporation applied to its equipment and materials for the fluorescent penetrant inspection methods which are covered by U. S. Letters Patent No. 2,259,400.

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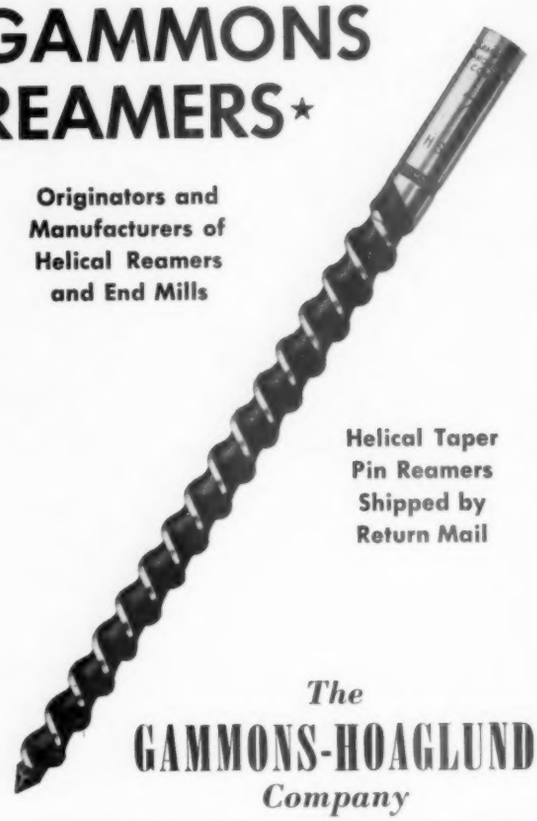
GAMMONS REAMERS*

Originators and Manufacturers of Helical Reamers and End Mills



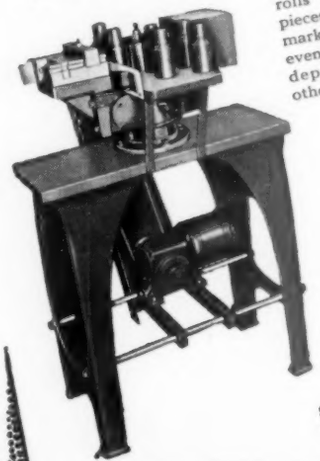
Helical Taper Pin Reamers Shipped by Return Mail

The GAMMONS-HOAGLUND *Company*

400 MAIN STREET, MANCHESTER, CONN.

Marks up to 5,000 pieces an hour!

FORCE HORIZONTAL ROTARY MARKING MACHINE



A motor-driven turntable rolls conical or cylindrical pieces against a stationary marking head making sharp, even impressions of uniform depth. Lot numbers and other identifying symbols can be indented in pieces up to 4" in diameter.

Pieces varying slightly in diameter are marked uniformly because of the spring cushion action of the marking head. Pressure support rollers easily mark steel and other hard metals . . . impressions easily changed since interchangeable steel type is used in the marking head.

Send us blueprints or work samples for full information and exact quotation.

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...high speed drills!

FASTER FEEDS because 15% shorter length—sturdier construction

FASTER FEEDS because shorter length reduces vibration at the cutting edges

● It has been known for years that the conventional Jobbers Length twist drill is not designed for maximum performance under most modern plant conditions. This is because the Jobbers Length drill was designed over forty years ago—for much slower speeds and feeds.

Republic engineers designed the new Mechanics Length High Speed Drill to meet the need for a shorter length stock drill. It is 15% shorter than the conventional Jobbers Length; and the shorter flute results in a sturdier drill, with minimum vibration at high speeds and much greater drill life on practically every job. For portable drilling and screw machine work, the great advantage of the Mechanics Length is obvious, since shorter drills have been used on this work for many years. 15% shorter length means 15% lower price, too!

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New bulletin gives sizes, prices, advantages of the new Republic Mechanics Length Drills...Use the coupon to get your copy.

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Bryant Thread Gage

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The new Bryant Adjustable External Thread Gage is designed to fill your need for a **universal** thread gage. By providing speedy and highly accurate inspection for varying sized parts having the same pitch and thread form, the new gage is particularly valuable for plants maintaining high production sched ules on numerous sizes of threaded parts. In fact a quality control department using several of these gages, each set to accommodate a different thread form and pitch, will cut inspection time and costs to a new low.

The use of the proven Bryant Thread Gage principle makes operation simple. The operator uses one hand to control the opening and closing of the thread segments, the other inserts the part and gives it a third of a turn to inspect the threads all over. A large dial indicates accuracy immediately.

The segments are designed to maintain 90 degree contact with the work regardless of diameter, within a range of 1 to 2½ inches. Accommodation of various pitches and thread forms is accomplished with easily changed thread segments. The segments are long lived. Wear is slight because of single point contact of work to segment. If the segments become worn, the front face can be ground off to present sharp new thread contacts.

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Now Bryant offers you a faster, cheaper and **visual** means for accurately checking threaded parts of **many sizes on one gage**—write for information today.

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Prices and Specifications
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Special tool designing requirements; reamer usage; sharpenings; special instructions on reconditioning Staples Expansion Reamers; standard keyways and tapers; decimal equivalents and tap drill sizes.

Staples CARBOLOY-TIPPED CIRCULAR CUTTING TOOLS

REAMERS • CORE DRILLS • SPOT FACERS • COUNTERBORES • END MILLS • SHELL END MILLS • ALSO A COMPLETE LINE OF CIRCULAR SPECIAL TOOLS

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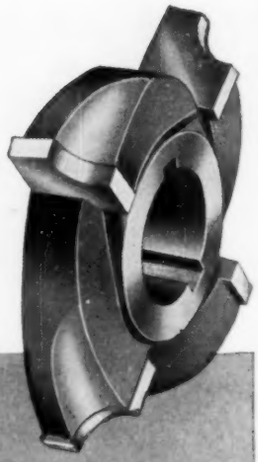
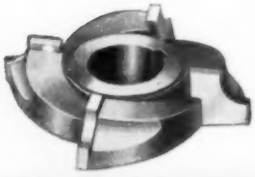
For FASTER SMOOTHER CUTTING, LONGER LIFE and BETTER FINISH—



Meyers

Carbide Tipped FORM TOOLS



The Meyers method of generating carbide-tipped tools insures the accuracy of each radius. On milling cutters all teeth are precisely uniform, thereby distributing the work evenly over the entire cutter. This accuracy and uniformity increases the life of the tool amazingly, and insures a much better finish on the work.

We are equipped to grind tools to your specifications, and to engineer special tools for your particular job. Write for complete information, or send us your prints for a quotation.

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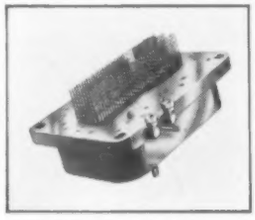
The Zagar Gearless Drillhead can accommodate up to 400 drills in one head—drill up to 400 holes at one time! This revolutionary unit runs noiselessly and vibration-free on needle, tapered roller and precision ball bearings, and is lubricated by a patented automatic oiling system to insure trouble-free operation.



Zagar 220 Spindle Gearless Drillhead

With this unit all holes are drilled at one pass, and valuable time is saved by the elimination of indexing and extra handling. It may be used on standard drill presses, or furnished as a complete hydraulic machine by the factory.

Another time saver, as well as a help on a tedious job, is chewing gum. The simple act of chewing seems to make the work go faster, easier—helping to relieve worker's fatigue—so that a better piece of work can be turned out with greater safety. Wrigley's Spearmint Gum may be used even when both hands are busy—right where the work is being produced.

You can get complete information from
Zagar Tool, Inc.
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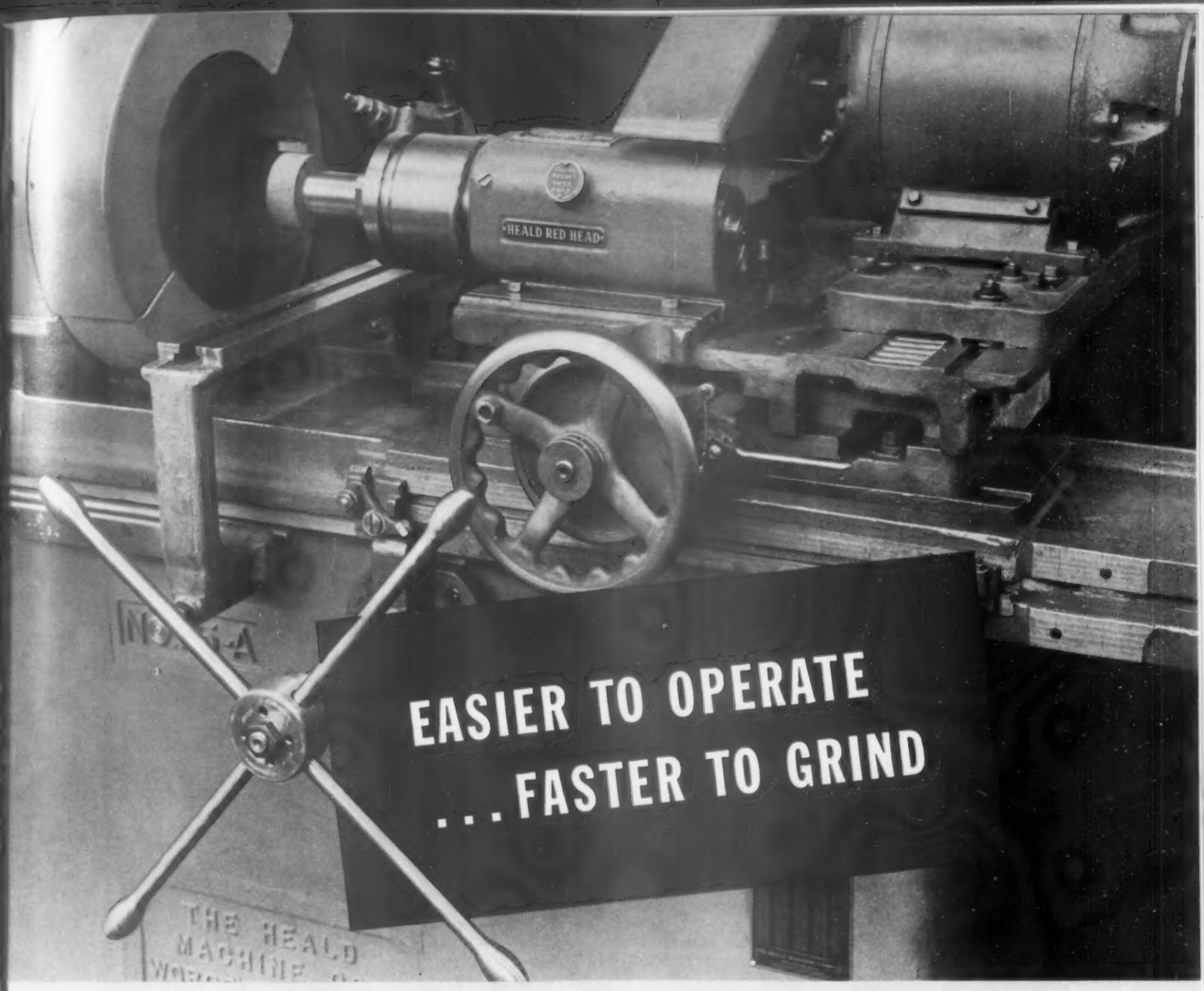
AA-99



It's the Heald No. 75-A Internal, with new anti-friction table ways . . . ready to cut your small-lot grinding costs

EFFICIENCY in small-lot grinding jobs largely depends on ease of operation. And that's one of the outstanding features of the Heald No. 75-A Internal, equipped with new anti-friction table ways for faster, effortless grinding.

Table action on this simple, manually operated Heald Internal is remarkably smooth and easy . . . a mere touch on the handwheel operates the table, hence greatly reduces operator fatigue. Ways are prelubricated for life . . . give instantaneous table response . . . put finger-control precision into small-lot operations.

That's why the Heald No. 75-A Internal is ideal for your tool room—with ample capacity for the general run of face, chamfer and internal grinding. Use it for work up to 2" in length, with either straight or tapered holes, such as gears, pinions, bushings, and rings. You'll find that it increases the range of your work . . . and brings your costs down.

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Right flat form tool holder for Gridley, Acme-Gridley, and New Britain Gridley
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Dovetail form tool holder for Gridley, Acme-Gridley, and New Britain Gridley
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ALL AUTOMATIC
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A few years later the Parker Ball Bearing was patented to meet high speed and precision requirements and has been in use ever since.

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Top Performance Consistently Duplicated
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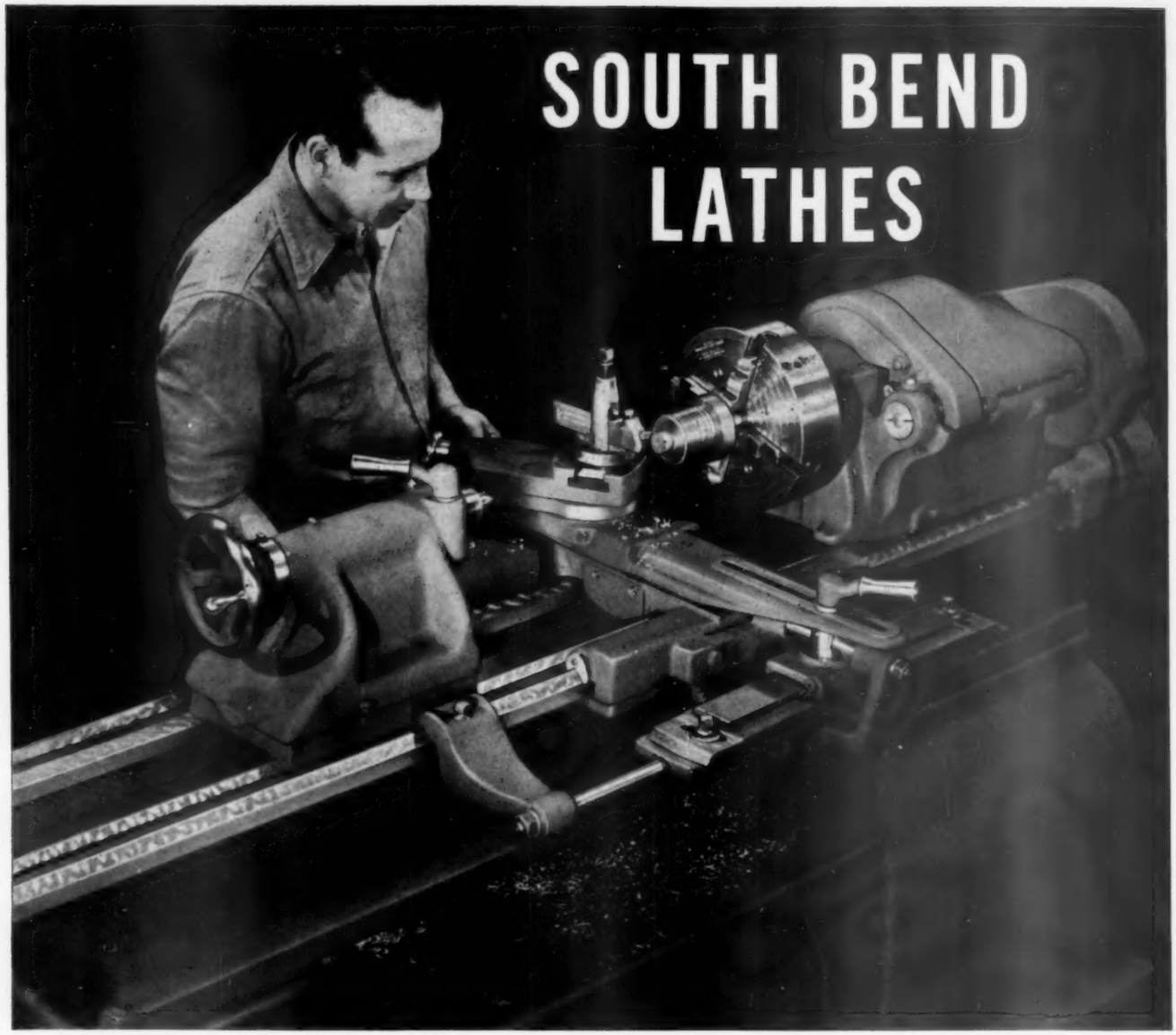

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South Bend Precision Lathes are designed and built to meet the exacting needs of today's industries. Their accuracy, and ability to handle a wide variety of operations, raise standards of quality in the toolroom, speed tooling, keep costs to a minimum. These same features—plus speed, ease of operation, and dependability—raise quality levels in the manufacturing plant, step up the flow of production, lower costs by reducing the amount of "machine scrap," and, in some instances, by eliminating the need for one or more finishing operations.

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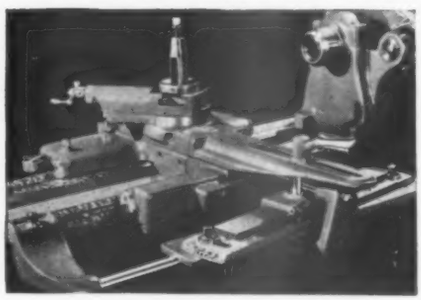

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Write for Catalog 77 which illustrates and describes the complete line of South Bend Lathe attachments and accessories. Mailed without obligation.

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Available in 2, 3, 4 column, and open gap types, capacities 5 tons to 150 tons, for straightening, forming, press assembly, and similar operations involving the application of pressure. Column spacing, ram stroke, table construction, speeds and controls may be readily modified to suit individual needs.

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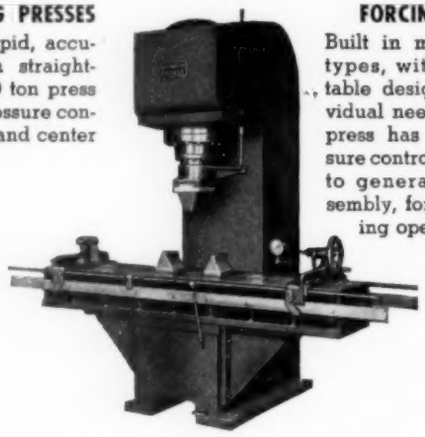
Designed for rapid, accurate production straightening. This 100 ton press has sensitive pressure control, long table and center type fixture.

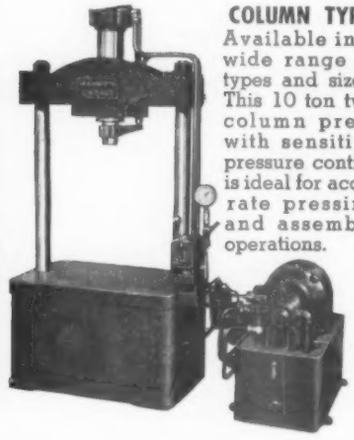


FORCING PRESSES

Built in many sizes and types, with control and table design to suit individual needs. This 75 ton press has sensitive pressure control and is adapted to general press-fit assembly, forcing and forming operations.

COLUMN TYPE

Available in a wide range of types and sizes. This 10 ton two column press with sensitive pressure control is ideal for accurate pressing and assembly operations.



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Disc type for positive, accurate control of air operated equipment. Efficient disc type design without packing prevents leakage and waste of air power, does away with packing maintenance troubles. The bronze disc controlling air flow is ground and lapped to make a perfect seal with the valve seat. Made in 3-way and 4-way types for control of single and double acting cylinders in hand or foot models, spring return, heavy duty rotary, manifold, and electric models. Also piston type pressure regulating valves.

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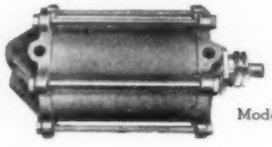
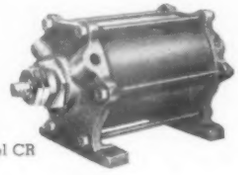
Provide simple outside adjustment of the soft piston packing, allowing easy maintenance of the high efficiency piston seal with minimum friction loss. All sizes are bored and honed for straight, round-mirror finish cylinder bore—a better finish that means better cylinder performance. Built in a full line of standard mountings, sizes 1 to 6 inch bore, for any length stroke, with or without cushion.



Model ER



Model CR

"HY-POWER" HYDRAULIC RIVETERS

For high speed production riveting, punching, pressing. Portable and stationary types available, designed for easy handling and consistent rapid production. Capacities 7½ to 100 tons. The automatic operating cycle is push-button controlled and includes rapid advance stroke, automatic high pressure working stroke, automatic reversal, rapid return stroke. The hydraulic pressure generator is a compact motor driven unit. "Hy-Power" equipment is adaptable to a wide range of riveting, punching, and pressing operations.

HYDRAULIC CYLINDERS

With patented "no-tie-rod" design, providing a stronger cylinder assembly, simpler to apply, assuring high efficiency operation. End caps may be positioned independently without disturbing mounting, for simple, efficient piping. Mirror finish honing gives a cylinder bore that is straight, round, perfectly finished. High efficiency piston seal with minimum fluid slip is assured. Seven standard mounting types; special mountings and large sizes built to order.

Model EN

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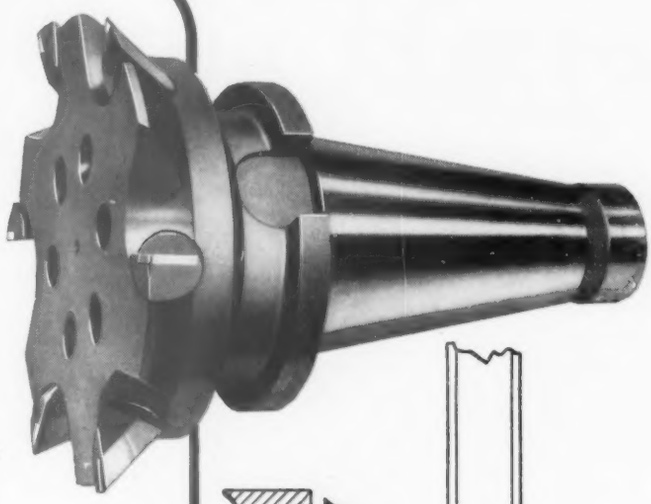
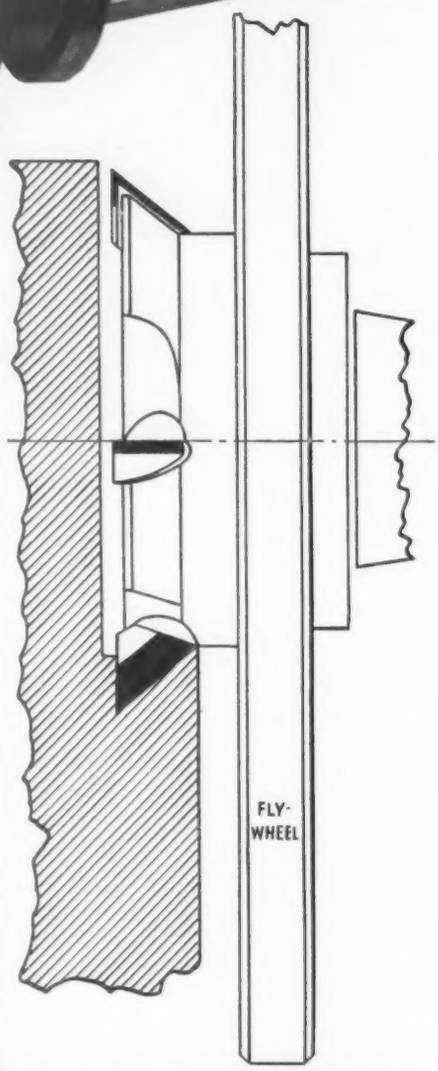
Announcing the **NEW** LOVEJOY

DOVETAIL CUTTER



The new Lovejoy Dovetail Cutter offers a faster and more economical method for forming dovetails, milling vee-slots or cutting angles: For example, the outstanding performance of the new cutter is clearly shown in the following data collected on a typical job.

OPERATION:	*Milling Dovetail Slots*
MATERIAL:	*Cast Iron*
FEED:	*13 inches per minute*
SPEED:	*200 r. p. m.*
DEPTH OF CUT:	*½ inch*
TIP MATERIAL:	*883 (Tungsten Carbide)*
RAKE ANGLES:	*+ 2 degrees Radial, 0 degrees Helical*
PERFORMANCE:	*The 6-inch 6-bladed cutter was run with a 70 lb. Flywheel. The cutting action was free and even; finish very smooth. After running 1400 lineal inches to complete the job, the blades showed inappreciable wear.*



Such productive ability results from functional design that embodies the most modern metal cutting features — inserted-type, carbide-tipped blades for utmost economy—a rugged forged steel cutter body for maximum blade support—and the famous Lovejoy Positive Blade Locking Device.

With speedier, cheaper, accurate production, the result of using the new Lovejoy Dovetail Cutter, it will pay you to write for complete details.

LOVEJOY
TOOL COMPANY, INC.
Springfield, Vermont, U. S. A.

SHELDON precision

See Our Exhibits at "Metal Show," Atlantic City, Nov. 18 to 22.
"Power Show," New York, Dec. 2 to 7.

SHELDON S-56
11¼" swing
1" collet capacity
56" bed

SHELDON *precision* is of the new type; is the precision of modern manufacturing methods—a specially designed machine tool plant, tooled to the nth degree with the finest machine-tool building equipment. From this plant come precision lathes, milling machines and shapers — quality machine tools built to the closest tolerances on a quantity production basis much like a fine aircraft engine. Possibly equally accurate tools can be built "by hand" but only at far greater cost.

That is why SHELDON can always give "more tools for the money"—more accuracy, more capacity, more features and inherent quality. That is why it is always smart to "See the Sheldon at your distributors before you buy."

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Manufacturers of Sheldon Precision Lathes • Arbor Presses • Vises
Sheldon-Vernon Horizontal Milling Machines • Vertical Milling Machines and Jig Borers • Shapers
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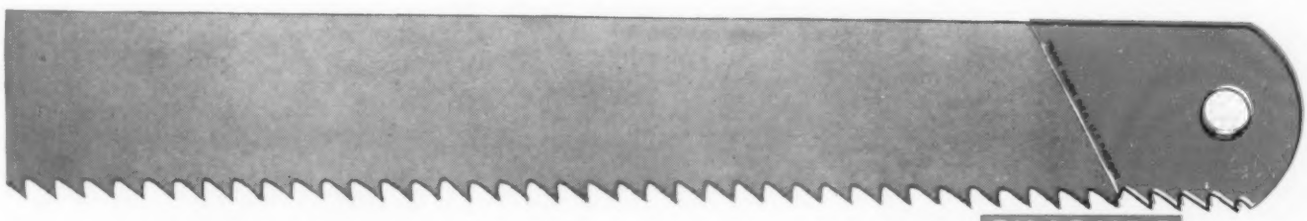
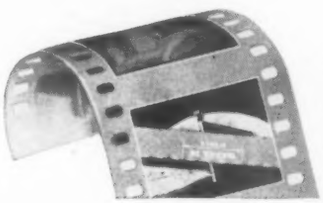
Get SIMONDS

"RED END" HACKSAW BLADES

. . . AND GET A LONGER RUN

FOR YOUR MONEY





SEE SIMONDS SOUND-FILM, in color, showing how to get the best results and longest service out of the finest blades made . . . SIMONDS "Red End" Blades for Hand and Power Hacksawing. You can arrange with your Industrial Supply Distributor for a showing of this interesting movie. Or write to the nearest Simonds office.

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A Size For Every Purpose

The indestructible drive and rigid, yet simple, construction of the Continental Interchangeable Counterbore assure long and dependable service. The holder and cutter are disengaged by a twist of the wrist; no tools or equipment are needed, no matter how severe the operation has been.

Continental Interchangeable Counterbores are now available in a choice of three sets, each providing a wide variety of useful, dependable tools. In complete yet compact form, you will find a selection designed to fill the needs of the large or small toolroom. Set No. 1 (illustrated), for the small shop, includes cutters up to 1 1/16" diameter, with two holders. Set No. 2, also with two holders, has cutters up to 1 1/2" diameter. Set No. 3 provides cutters up to 2" diameter and has four holders. Whichever you choose, you will be sure to get fine, precision-made cutting tools.

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Division of Ex-Cell-O Corporation

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EX-CELL-O CORPORATION

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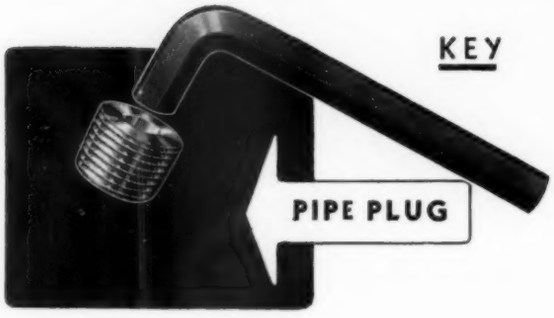

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THE BETTER . . . . . FASTENING METHOD

More compact design because members need not be "built up" (saving of weight), point of fastening held closer to intersection of parts (saving of space), quick and positive tightening (saving in assembly time) . . . these and many more proven facts are the results of using Holo-Krome FIBRO FORGED Socket Screws with the internal wrenching feature . . . Holo-Krome Screws are the completely cold forged screws — a Holo-Krome exclusive, patented feature.

THE HOLO-KROME SCREW CORP.
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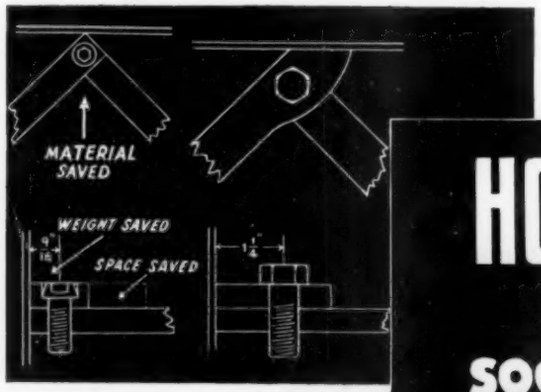

SAVE WEIGHT - SPACE
ASSEMBLY - TIME

HOLO-KROME
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INTERNAL
SOCKET SCREWS
WRENCHING

Your Holo-Krome Industrial Distributor is ready to serve you from his warehouse stock.

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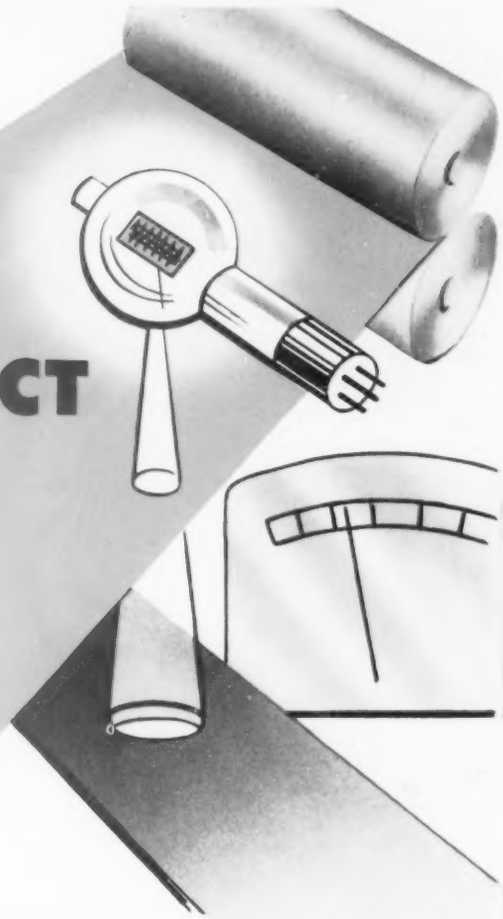
WITHOUT CONTACT



At a Speed as Fast as Light!

Hot sheets or strips of metal or foil flying from the rolls; paper emerging in a never-ending sheet; or the plastic or rubber blanket flowing from a calender, may be checked instantly for thickness, and this thickness controlled during the process, by the Sheffield Measuray.

Temperature of the material to be checked and its speed of movement do not affect the accuracy of the thickness check. Proximity of gaging head to material is not important—it can be as much as a foot or more distant, depending upon the application. Amplification and sensitivity are available in excess of any known industrial requirements without sacrifice in speed, range, or dependability. For instance, it is possible to amplify one per cent of the thickness of the stock being checked to extend over the full scale range.

The Measuray may be mounted on a production machine, or it may be used at the bench to measure stationary objects, especially those whose surfaces might be marred by a contact gage, or those of such resiliency that the contact gage measurements are not practicable.

See the Measuray demonstrated at the Sheffield plant in Dayton. Bring samples of work to be checked to see for yourself the savings in material and time, elimination of losses in destructive testing, and the increase in uniform quality which the Sheffield Measuray can bring you.

If a visit is not convenient, write us for detailed information. For an early installation, ask for a survey to be made in your plant by Sheffield engineers—no obligation on your part.

Real job security is only provided by plentiful incoming orders shipped at prices consumers can afford and want to pay . . . modern machine tools help make this possible.

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2307

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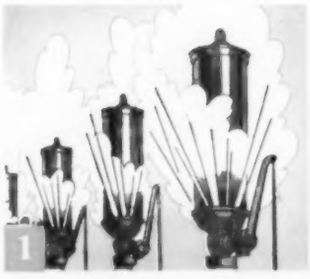
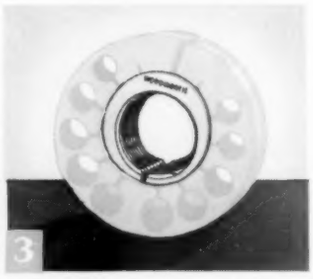


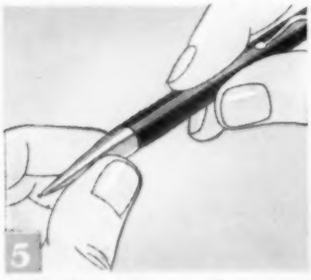
Blow all the whistles! They've done it again!

Blast out a fanfare for a great new Woodworth invention!

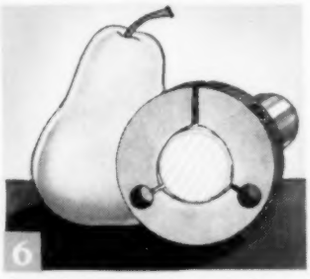


It's the Woodworth Adjustable Thread Ring Gage.

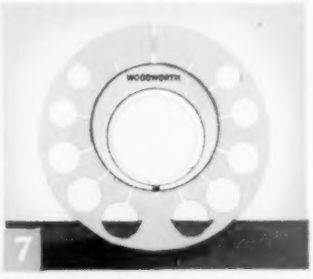
Thread ring gages check the O.D. of threaded parts.



Adjusting 'em as they wear down saves time and money.

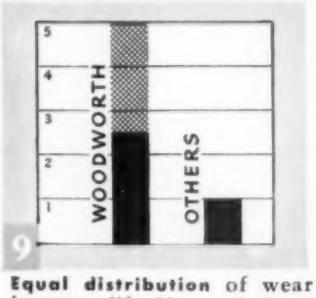


But old types get pear-shaped —lose accuracy—wear out fast.



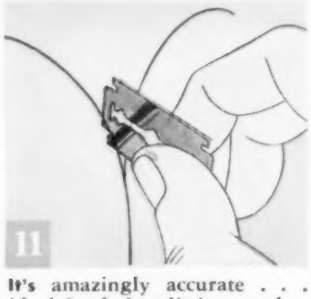
This Thread Ring Gage adjusts perfectly — *stays round.*

Never gets out of line when dropped or thrown about.



Equal distribution of wear increases life 2½ to 5 times.

Light weight reduces operator fatigue — increases sensitivity.



It's amazingly accurate . . . ideal for hair-splitting work.

Woodworth's New Thread Ring Gage is an all-time champion!

Another Woodworth contribution to production

THE NEW Adjustable Thread Ring Gage, another revolutionary Woodworth instrument of accuracy, is now available to industry!

Employing an entirely new principle of design, and proven mathematically correct by actual tests, this gage assures roundness through the maximum range of adjustment.

Check these
Five Important Advantages

1. *Greater Accuracy and Stability.* Stays round with adjustment. Threads held in alignment of thread helix angle with adjustment. Will not reject parts that should pass inspection.

2. *Longer Wear Life.* Equal distribution of wear over the full thread circumference, throughout the entire range of adjustment, increases wear life 2½ to 5 times.

3. *Less Weight.* Aluminum alloy outer body halves the weight to greatly reduce operator fatigue and increase sensitivity.

4. *Positive Identification.* Green outer body for GO GAGE and red for NOT GO GAGE saves time for operator.

5. *Positive Adjustment.* Cannot be thrown out of adjustment by ordinary blows or falls that change setting of conventional gages.

You can speed up production and decrease gaging costs on your thread inspection operations with this amazing instrument! Write for completely illustrated folder 46-R.

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